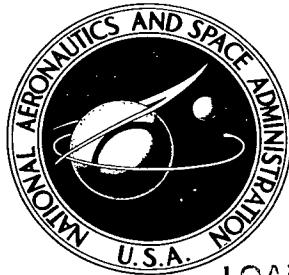


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AERODYNAMIC DATA ON LARGE SEMISPAN
TILTING WING WITH 0.6-DIAMETER CHORD,
SINGLE-SLOTTED FLAP, AND SINGLE
PROPELLER ROTATING DOWN AT TIP

by Marvin P. Fink, Robert G. Mitchell,
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SUMMARY

An investigation has been made in the Langley full-scale tunnel to determine the longitudinal aerodynamic characteristics of a large-scale semispan V/STOL tilt-wing configuration having a single propeller with propeller rotation such that the blades rotated downward at the wing tip and upward near the root. The wing had a chord to propeller-diameter ratio of 0.6, a single-slotted flap, an aspect ratio of 4.05 (2.025 for the semispan), a taper ratio of 1.0, and an NACA 4415 airfoil section.

The data have not been analyzed in detail, but have been examined to observe general trends. A few such trends predominate. First, the portion of the wing outboard of the nacelle practically never stalls - evidently because of the wing-tip effect and because of the reduction in angle of attack over that portion of the wing caused by the slipstream rotation which is downward at the wing tip. The stall starts at the trailing edge of the wing root and progresses smoothly forward and outboard. Second, the use of the leading-edge slat is beneficial in that it extends the lift curves to higher angles of attack and higher maximum lift coefficients with the flap down at moderate values of thrust coefficient and it was also beneficial with flap up at low values of thrust coefficient. The slat, however, does little or no good at other conditions insofar as the force-test data are concerned. The final point noted in the data is that neither the Krueger flap nor the drooped leading edge have any appreciable beneficial effect insofar as the force data are concerned, but they do help relieve the inboard stall at conditions of high flap deflection and thrust coefficient and would consequently be expected to lessen any buffeting problem arising from this source.

INTRODUCTION

Most of the aerodynamic research that has been done on the tilt-wing propeller-driven V/STOL configuration in the past has been of an exploratory character and has been obtained with small-scale models. The interest in this type of airplane has now become so substantial, however, that there is a need

for large-scale systematic aerodynamic design data. A program has therefore been inaugurated at the Langley Research Center to provide such information by means of a large-scale semispan tilt-wing-and-propeller model in the Langley full-scale tunnel. One report (ref. 1) has already been issued on the investigation; and the results of the second part of the investigation are reported herein. The present series of tests were made on a model having a single propeller on the semispan wing and having a chord-diameter ratio of 0.6, a 40-percent-chord single slotted flap, and three different leading-edge flow-control devices - a slat, a droop nose, and a Krueger flap. The investigation covered a range of angle of attack from -20° to 90° and a range of power conditions from zero thrust to that required for hovering. The direction of propeller rotation was such that the blades were going downward at the wing tip. The lift, drag, and pitching moments of the model were measured over the range of test conditions and the flow was observed by means of tufts on the upper surface of the wing. The results of this investigation are presented herein without detailed analysis in order to expedite their dissemination.

SYMBOLS

The positive sense of forces, moments, and angles is shown in figure 1. The pitching-moment coefficients are presented with reference to the wing quarter-chord line. The coefficients are based on the dynamic pressure in the propeller slipstream. Conventional coefficients based on the free-stream dynamic pressure can be obtained by dividing the slipstream coefficients by

$$1 - C_{T,s}; \text{ for example, } C_L = \frac{C_{L,s}}{1 - C_{T,s}}.$$

The coefficients and symbols used in this paper are defined as follows:

$$C_L \quad \text{lift coefficient based on free airstream, } \frac{L}{q_S}$$

$$C_{L,s} \quad \text{lift coefficient based on slipstream, } \frac{L}{q_S S}$$

$$C_{D,s} \quad \text{drag coefficient based on slipstream, } \frac{D}{q_S S}$$

$$C_{m,s} \quad \text{pitching moment based on slipstream, } \frac{M_Y}{q_S S c}$$

$$C_{T,s} \quad \text{thrust coefficient based on slipstream, } \frac{T}{q_S \frac{\pi D^2}{4}}$$

b	propeller blade chord, ft
c	wing chord, ft
D	propeller diameter, ft; also, total model drag, lb
h	width of slat or of flap-slot gap; also thickness of propeller blade, in.
L	total model lift, lb
M _Y	pitching moment, ft-lb
q	free-stream dynamic pressure, $\frac{\rho V^2}{2}$, lb/sq ft
q _S	slipstream dynamic pressure, $q + \frac{T}{\frac{\pi D^2}{4}}$, lb/sq ft
r	radius to element on propeller blade, in.
R	radius of propeller blade (34 in.)
S	area of semispan wing (23.62 sq ft)
T	propeller thrust, lb
α	angle of attack, deg
δ_f	flap deflection, deg
δ_s	leading-edge-slat deflection, deg
δ_n	droop-nose deflection, deg
δ_K	Kreuger flap deflection, deg
ρ	mass density of air, slugs/cu ft
V	free-stream velocity, ft/sec

APPARATUS

The model used in this investigation was a semispan model which would represent the left panel of a full-span wing. The principal dimensions are

given in figure 2(a), the propeller blade characteristics are given in figure 2(b), and a photograph showing the model mounted in the Langley full-scale tunnel is presented in figure 2(c). The wing was mounted on the scale balance system in the tunnel so that lift and drag measurements were read directly about the wing axis. At the point where the wing extended through the reflection plane, very soft sponge rubber was used as a seal to prevent air from leaking through the reflection plane at the wing root.

The model was constructed to allow numerous changes to be made in the test configuration, such as a change of airfoil, leading-edge modification, trailing-edge flap, direction of rotation of the propeller, and wing planform. The basic structure of the wing consists of a heavy steel box-beam spar to which a power train to drive the propellers through spanwise shafting is attached and around which various airfoil contours can be fitted.

The model configuration for the present tests had a 68-inch-diameter propeller having the characteristics shown in figure 2(b). The propeller location was such that the propeller tip extended out to the wing tip. The direction of propeller rotation was down at the wing tip and up at the root. This mode of rotation is sometimes referred to as "against the tip vortex." The propeller thrust was measured by a strain-gage balance which was part of the propeller shaft. The output was fed through slippings to an indicating instrument. The required values of thrust for each $C_{T,s}$ were set by the operator by changing the speed of the drive motor. The blade angle at the 0.75R station of the propeller was held constant at 17° throughout the investigation. The thrust axis was inclined upward 4° from the chord line of the wing to correspond approximately to the zero-lift line of the airfoil section.

The airfoil used was the NACA 4415 section with a 41-inch chord. This chord length gave a ratio of wing chord to propeller diameter of 0.6. The reference area of the wing based on a semispan of 83 inches was 23.62 square feet, which did not include the area of the tip fairing.

The model had a 40-percent-chord single-slotted flap which had a deflection range from 0° to 50° . Figure 3 shows the flap in the 50° deflected position and also shows the slot geometry.

The three leading-edge flow-control devices shown in figure 3 were investigated in combination with the flap on this model. These devices were a Krueger flap, a drooped nose, and a leading-edge slat. The Krueger flap, which in the retracted position in actual use would form the bottom contour of the nose section, was constructed of sheetmetal and was hinged at the 0.017c station. Its deflection could be varied from 30° to 90° in increments of 10° . Leading-edge droop was provided by deflecting the entire nose section about a hinge point on the lower surface at the 0.17c station. The droop for these tests was set at a deflection of 30° . For the leading-edge slat, two deflection angles (20° and 30°) and two slat gaps (0.0244c and 0.0122c) were originally provided. Some preliminary tests showed little change in the results with variation of slat angle and gap; consequently, the present tests were made only with a 20° deflection and an 0.0244c gap.

TESTS, RESULTS, AND DISCUSSION

Before the tests were begun, it was necessary to determine the nature of the tunnel conditions in which the model would be operating. Extensive surveys at the model location and 20 feet ahead of the model were made with the tunnel empty and at 20 feet ahead of the model with the model installed and operating at a high-lift configuration. It was found that because of the small size of the model in relation to the tunnel size, the model had very little effect on the flow. Dynamic-pressure variation was about 1.0 percent and changes in stream angles were less than 0.5° . Consequently, no corrections have been applied to the data.

The tests were made for a range of single-slotted flap deflections and a combination of leading-edge flow-control devices. The specific configurations tested, together with a list of tables and figures in which the data for each may be found, are given in the following table:

Leading-edge configuration	Flap deflection, deg	Table	Figure
Basic leading edge	$\delta_f = 0$ $\delta_f = 20$ $\delta_f = 40$ $\delta_f = 50$	1 2 3 4	4 5 6 7
Leading-edge slat: Inboard section; $\delta_s = 20^\circ$ Inboard section; $\delta_s = 20^\circ$ Inboard section; $\delta_s = 20^\circ$ Inboard section; $\delta_s = 20^\circ$ Full span; $\delta_s = 20^\circ$ Full span; $\delta_s = 20^\circ$	$\delta_f = 0$ $\delta_f = 20$ $\delta_f = 40$ $\delta_f = 50$ $\delta_f = 40$ $\delta_f = 50$	5 6 7 8 9 10	8 9 10 11 12 13
Krueger flap: Full span; $\delta_K = 40^\circ$ $\delta_K = 50^\circ$ $\delta_K = 70^\circ$ Inboard section; $\delta_K = 50^\circ$ Inboard section faired to leading edge; $\delta_K = 50^\circ$	$\delta_f = 50$ $\delta_f = 50$ $\delta_f = 50$ $\delta_f = 50$ $\delta_f = 50$	11 12 13 14 15	14 15 16 17 18
Droop nose: Inboard section; $\delta_n = 30^\circ$	$\delta_f = 50$	16	19

The tests were made over a range of thrust coefficients from 0 to 1.0, and for any given test the thrust coefficient was held constant over the angle-of-attack range by adjusting the propeller speed to give the required thrust at each angle of attack. The angle-of-attack range for the tests was approximately

from the angle required for zero lift to that required to stall the wing or to develop a drag-lift ratio of about 0.3, whichever was lower, except for $C_{T,s} = 1.0$ (the static thrust case) where the angle-of-attack range was 0° to 90° . The test Reynolds number, based on the wing chord length and the velocity of the propeller slipstream, was about 2.8×10^6 for thrust coefficients from 1.00 to 0.30. For the $C_{T,s} = 0$ condition which was run at zero thrust, the Reynolds number was about 2.3×10^6 .

The data have not been analyzed in detail, but have been examined to observe general trends. A few such trends predominate. First, the portion of the wing outboard of the nacelle practically never stalls - evidently because of the wing-tip effect and because of the reduction in angle of attack over that portion of the wing caused by the slipstream rotation which is downward at the wing tip. The stall starts at the trailing edge of the wing root and progresses smoothly forward and outboard. It progresses smoothly from the center section, which is not in the propeller slipstream, on to the portion of the wing in the propeller slipstream inboard of the nacelle. The fact that the part of the wing in the slipstream inboard of the nacelle stalls before the part outboard of the nacelle is evidently the result of the direction of propeller (and slipstream) rotation which causes the inboard section to be at a higher angle of attack. This was not the case in the tests of reference 1 with opposite rotation, and in that case the stall did not progress smoothly from the root outward into the portion of the wing in the slipstream.

Second, the results of the tuft tests seem to correlate with the results of the force tests; that is, there are developments in the stall patterns on the wing (particularly for the low thrust coefficients, $C_{T,s} = 0.6, 0.3$, and 0) that correlate with breaks in the lift curves. This effect would seem to be the natural happening, but it was not the case for the previous tests reported in reference 1 for the same model with opposite propeller rotation (up at the tip) and a Fowler flap instead of the present slotted flap.

Third, the use of the leading-edge slat is beneficial in that it extends the lift curves to higher angles of attack and higher maximum lift coefficients with the flap down at moderate values of thrust coefficient ($C_{T,s} = 0.6$ to 0.8), and it was also beneficial with flap up at low values of $C_{T,s}$. The slat, however, does little or no good at other conditions insofar as the force-test data are concerned. The slat does have some beneficial effect at high thrust coefficients, however, in that it delays the onset and progression of the stall. This effect does not show up in the force tests, probably because the forces under these high $C_{T,s}$ conditions are largely a function of propeller thrust and are influenced only to a much smaller degree by the wing lift. The effect of the slat in relieving the stall under these high thrust coefficient conditions, however, might be very important in relieving buffeting on an actual airplane. For example, it was found in the flight tests of a tilt-wing VTOL airplane reported in reference 2 that wing stall and separation control by a leading-edge device appreciably improved the handling qualities and increased the rate of descent of the airplane by reducing buffet. The data also show that the inboard slat alone is as effective as the full-span slat - apparently because

the outboard portion of the wing is protected from stalling by the rotation of the propeller slipstream and consequently does not need a slat.

The final point noted in the data is that neither the Krueger flap nor the drooped leading edge have any appreciable beneficial effect insofar as the force data are concerned, but they do help relieve the inboard stall at conditions of high flap deflection and thrust coefficient and would consequently be expected to lessen any buffeting problem arising from this source. In this connection the inboard Krueger flap alone was found to be as effective as the full-span flap just as the inboard slat was as effective as the full-span slat.

CONCLUSIONS

An investigation to obtain large-scale aerodynamic data and flow studies on a semispan wing for an angle-of-attack range from -20° to 90° for thrust coefficients from 0 to 1.0 indicates the following conclusions:

1. The part of the wing outboard of the nacelle practically never stalls - evidently because of the wing-tip effect and because of the reduction in angle of attack over that part of the wing caused by the slipstream rotation which is downward at the tip. The stall starts at the trailing edge of the wing root and progresses smoothly forward and outboard.
2. The use of the leading-edge slat is beneficial in that it extends the lift curves to higher angles of attack and higher maximum lift coefficients with the flap down at moderate values of thrust coefficient, and it was also beneficial with flap up at low values of thrust coefficient. The slat, however, does little or no good at other conditions insofar as the force-test data are concerned.
3. Neither the Krueger flap nor the drooped leading edge have any appreciable beneficial effect insofar as force data are concerned, but they do help relieve the inboard stall at conditions of high flap deflection and thrust coefficient and would consequently be expected to lessen any buffeting problem arising from this source.

Langley Research Center,
National Aeronautics and Space Administration,
Langley Station, Hampton, Va., May 2, 1964.

REFERENCES

1. Fink, Marvin P., Mitchell, Robert G., and White, Lucy C.: Aerodynamic Data on a Large Semispan Tilting Wing With 0.6-Diameter Chord, Fowler Flap, and Single Propeller Rotating Up at Tip. NASA TN D-2180, 1964.
2. Pegg, Robert J.: Summary of Flight-Test Results of the VZ-2 Tilt-Wing Aircraft. NASA TN D-989, 1962.

TABLE 1.- TABULATED AERODYNAMIC DATA FOR $\delta_x = 0^\circ$, $\delta_n = 0^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$			
-20	-----	-----	-----
-15	-----	-----	-----
-10	-----	-----	-----
-5	-----	-----	-----
0	0.115	-1.065	0.001
5	.218	-1.047	.009
10	.325	-1.021	.013
15	.415	-.988	.007
20	.489	-.948	0
25	-----	-----	-----
30	.653	-.848	0
35	-----	-----	-----
40	.771	-.733	-.026
45	-----	-----	-----
50	.872	-.592	-.034
55	-----	-----	-----
60	.957	-.437	-.045
65	-----	-----	-----
70	1.015	-.271	-.059
75	-----	-----	-----
80	1.055	-.086	-.071
90	1.054	.103	-.062
$C_{T,s} = 0.95$			
-20	-0.379	-0.954	-0.055
-15	-.259	-.986	-.044
-10	-.132	-1.008	-.024
-5	-.014	-1.016	-.009
0	.121	-1.008	.001
5	.246	-.991	.016
10	.374	-.958	.017
15	.482	-.914	.025
20	.607	-.853	.026
25	.710	-.783	.026
30	.805	-.710	.032
35	.884	-.625	.031
40	.948	-.542	.030
45	1.010	-.455	.032
50	1.059	-.330	.035
55	1.085	-.222	.034
60	1.106	-.125	.036
65	1.121	-.013	.041
70	1.115	.081	.043
75	1.109	.188	.047
80	1.089	.267	.055
$C_{T,s} = 0.90$			
-20	-0.432	-0.871	-0.068
-15	-.301	-.926	-.059
-10	-.153	-.954	-.033
-5	-.007	-.963	-.016
0	.151	-.961	.003
5	.304	-.958	.016
10	.442	-.909	.028
15	.565	-.861	.039
20	.680	-.788	.035
25	.781	-.705	.037
30	.889	-.607	.044
35	.973	-.509	.043
40	1.046	-.397	.040
45	1.102	-.289	.044
50	1.137	-.171	.038
55	1.150	-.053	.016
60	1.159	.042	.045
65	1.142	.130	.050
70	1.125	.215	.059
75	1.093	.294	.074
80	1.065	.382	.074

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
-20	-0.495	-0.739	-0.085
-15	-.342	-.807	-.077
-10	-.160	-.842	-.042
-5	.016	-.847	-.024
0	.193	-.842	.002
5	.363	-.822	.018
10	.531	-.782	.038
15	.674	-.725	.047
20	.806	-.645	.043
25	.916	-.554	.046
30	1.002	-.427	.041
35	1.089	-.306	.037
40	1.155	-.178	.036
45	1.193	-.049	.032
50	1.205	.074	.035
55	1.194	.183	.039
60	1.171	.284	.044
65	1.136	.374	.047
$C_{T,s} = 0.60$			
-20	-0.611	-0.468	-0.112
-15	-.474	-.568	-.113
-10	-.232	-.597	-.079
-5	-.029	-.617	-.051
0	.216	-.616	-.013
5	.429	-.587	.012
10	.661	-.538	.034
15	.854	-.476	.055
20	1.004	-.381	.053
25	1.079	-.262	.042
30	1.161	-.150	.027
35	1.182	.021	.023
40	1.225	.156	.011
45	1.210	.274	.003
50	1.197	.386	.006
55	1.150	.460	.006
$C_{T,s} = 0.30$			
-20	-0.669	-0.113	-0.139
-15	-.614	-.237	-.126
-10	-.337	-.286	-.120
-5	-.045	-.309	-.079
0	.229	-.305	-.037
5	.503	-.277	.002
10	.788	-.216	.031
15	1.031	-.146	.053
20	1.205	-.035	.050
25	1.250	.095	.019
30	1.251	.247	.005
35	1.234	.375	-.014
40	1.235	.555	-.046
$C_{T,s} = 0$			
-20	-0.764	0.229	-0.129
-15	-.732	.087	-.191
-10	-.401	.006	-.150
-5	-.107	-.003	-.100
0	.228	.004	-.057
5	.546	.039	-.015
10	.868	.098	.022
15	1.165	.172	.044
20	1.381	.295	.048
25	1.258	.422	-.013
30	1.227	.562	-.036

TABLE 2.- TABULATED AERODYNAMIC DATA FOR $\delta_f = 20^\circ$, $\delta_n = 0^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$							
-20	----	----	----	-20	-0.218	-0.791	-0.173
-15	----	----	----	-15	-.019	-.831	-.166
-10	----	----	----	-10	.165	-.839	-.142
-5	----	----	----	-5	.340	-.826	-.131
0	0.289	-1.023	-0.081	0	.531	-.793	-.111
5	.390	-.998	-.075	5	.720	-.744	-.101
10	.481	-.961	-.075	10	.915	-.663	-.094
15	.569	-.910	-.074	15	1.071	-.578	-.089
20	.652	-.852	-.078	20	1.133	-.455	-.096
25	----	----	----	25	1.200	-.331	-.097
30	.758	-.740	-.087	30	1.245	-.209	-.093
35	----	----	----	35	1.287	-.086	-.090
40	.864	-.607	-.105	40	1.303	.031	-.076
45	----	----	----	45	1.284	.140	-.076
50	.953	-.449	-.111	50	1.247	.219	-.059
55	----	----	----	55	1.203	.306	-.042
60	1.018	-.291	-.129	60	1.159	.375	-.021
65	----	----	----				
70	1.049	-.097	-.132				
75	----	----	----				
80	1.046	.084	-.135				
90	1.017	.273	-.134				
$C_{T,s} = 0.95$							
-20	-0.158	-0.973	-0.133	-20	-0.264	-0.520	-0.200
-15	-.034	-.996	-.117	-15	-.059	-.587	-.219
-10	.102	-1.000	-.107	-10	.187	-.600	-.186
-5	.227	-.990	-.094	-5	.411	-.588	-.159
0	.366	-.965	-.087	0	.668	-.548	-.142
5	.488	-.925	-.080	5	.923	-.487	-.115
10	.618	-.871	-.083	10	1.186	-.389	-.115
15	.712	-.812	-.072	15	1.391	-.294	-.114
20	.816	-.726	-.070	20	1.537	-.158	-.099
25	.907	-.645	-.070	25	1.428	-.013	-.123
30	.980	-.562	-.068	30	1.401	.118	-.122
35	1.043	-.463	-.064	35	1.332	.231	-.116
40	1.083	-.356	-.053	40	1.312	.354	-.108
45	1.126	-.242	-.054	45	1.276	.448	-.097
50	1.147	-.141	-.054				
55	1.170	-.032	-.050				
60	1.166	.067	-.044				
65	1.150	.166	-.046				
70	1.129	.263	-.040				
75	1.097	.295	-.029				
$C_{T,s} = 0.90$							
-20	-0.182	-0.911	-0.147	-20	-0.365	-0.172	-0.213
-15	-.028	-.941	-.135	-15	-.115	-.277	-.261
-10	.129	-.948	-.116	-10	.198	-.286	-.232
-5	.280	-.935	-.103	-5	.469	-.271	-.208
0	.428	-.913	-.091	0	.808	-.215	-.184
5	.575	-.867	-.085	5	1.116	-.142	-.165
10	.719	-.803	-.077	10	1.450	-.042	-.155
15	.827	-.732	-.069	15	1.715	.074	-.140
20	.925	-.631	-.065	20	1.953	.318	-.131
25	1.020	-.523	-.068	25	1.731	.391	-.172
30	1.105	-.409	-.073	30	1.489	.506	-.161
35	1.177	-.288	-.073				
40	1.231	-.165	-.073				
45	1.259	-.040	-.067				
50	1.255	.058	-.056				
55	1.225	.130	-.047				
60	1.192	.205	-.031				
65	1.157	.288	-.019				
70	1.119	.355	-.009				
$C_{T,s} = 0.80$							
-20	----	----	----	-20	-0.218	-0.791	-0.173
-15	----	----	----	-15	-.019	-.831	-.166
-10	----	----	----	-10	.165	-.839	-.142
-5	----	----	----	-5	.340	-.826	-.131
0	0.289	-1.023	-0.081	0	.531	-.793	-.111
5	.390	-.998	-.075	5	.720	-.744	-.101
10	.481	-.961	-.075	10	.915	-.663	-.094
15	.569	-.910	-.074	15	1.071	-.578	-.089
20	.652	-.852	-.078	20	1.133	-.455	-.096
25	----	----	----	25	1.200	-.331	-.097
30	.758	-.740	-.087	30	1.245	-.209	-.093
35	----	----	----	35	1.287	-.086	-.090
40	.864	-.607	-.105	40	1.303	.031	-.076
45	----	----	----	45	1.284	.140	-.076
50	.953	-.449	-.111	50	1.247	.219	-.059
55	----	----	----	55	1.203	.306	-.042
60	1.018	-.291	-.129	60	1.159	.375	-.021
65	----	----	----				
70	1.049	-.097	-.132				
75	----	----	----				
80	1.046	.084	-.135				
90	1.017	.273	-.134				
$C_{T,s} = 0.60$							
-20	----	----	----	-20	-0.264	-0.520	-0.200
-15	----	----	----	-15	-.059	-.587	-.219
-10	----	----	----	-10	.187	-.600	-.186
-5	----	----	----	-5	.411	-.588	-.159
0	0.227	-.990	-.094	0	.668	-.548	-.142
5	.366	-.965	-.087	5	.923	-.487	-.115
10	.488	-.925	-.080	10	1.186	-.389	-.115
15	.618	-.871	-.083	15	1.391	-.294	-.114
20	.712	-.812	-.072	20	1.537	-.158	-.099
25	.816	-.726	-.070	25	1.428	-.013	-.123
30	.907	-.645	-.070	30	1.401	.118	-.122
35	.980	-.562	-.068	35	1.332	.231	-.116
40	1.043	-.463	-.064	40	1.312	.354	-.108
45	1.083	-.356	-.053	45	1.276	.448	-.097
50	1.126	-.242	-.054				
55	1.147	-.141	-.054				
60	1.170	-.032	-.050				
65	1.166	.067	-.044				
70	1.150	.166	-.046				
75	1.129	.263	-.040				
80	1.097	.295	-.029				
$C_{T,s} = 0.50$							
-20	----	----	----	-20	-0.365	-0.172	-0.213
-15	----	----	----	-15	-.115	-.277	-.261
-10	----	----	----	-10	.198	-.286	-.232
-5	----	----	----	-5	.469	-.271	-.208
0	0.227	-.990	-.094	0	.808	-.215	-.184
5	.366	-.965	-.087	5	1.116	-.142	-.165
10	.488	-.925	-.080	10	1.450	-.042	-.155
15	.618	-.871	-.077	15	1.715	.074	-.140
20	.712	-.812	-.069	20	1.953	.318	-.131
25	.816	-.726	-.065	25	1.731	.391	-.172
30	.907	-.645	-.060	30	1.489	.506	-.161
$C_{T,s} = 0$							
-20	----	----	----	-20	-0.445	0.165	-0.250
-15	----	----	----	-15	-.177	.048	-.312
-10	----	----	----	-10	.179	.029	-.274
-5	----	----	----	-5	.512	.063	-.244
0	0.227	-.990	-.094	0	.887	.112	-.216
5	.366	-.965	-.087	5	1.264	.183	-.198
10	.488	-.925	-.080	10	1.643	.314	-.194
15	.618	-.871	-.077	15	1.977	.435	-.179
20	.712	-.812	-.069	20	2.311	.601	-.171
25	.816	-.726	-.065	25	1.951	.777	-.211
30	.907	-.645	-.060	30	1.488	.821	-.201

TABLE 3.- TABULATED AERODYNAMIC DATA FOR $\delta_f = 40^\circ$, $\delta_n = 0^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$				
$C_{T,s} = 1.00$											
-20	-----	-----	-----	-20	0.023	-0.751	-0.240				
-15	-----	-----	-----	-15	.219	-.763	-.235				
-10	-----	-----	-----	-10	.420	-.755	-.221				
-5	-----	-----	-----	-5	.601	-.726	-.215				
0	0.391	-0.951	-0.144	0	.812	-.661	-.214				
5	.482	-.910	-.145	5	1.006	-.585	-.219				
10	.565	-.858	-.144	10	1.183	-.485	-.202				
15	.635	-.813	-.144	15	1.309	-.370	-.211				
20	.703	-.757	-.147	20	1.331	-.236	-.198				
25	-----	-----	-----	25	1.362	-.094	-.202				
30	.793	-.632	-.158	30	1.400	.044	-.213				
35	-----	-----	-----	35	1.396	.167	-.199				
40	.879	-.508	-.173	40	1.342	.243	-.171				
45	-----	-----	-----	45	1.293	.322	-.143				
50	.957	-.333	-.182	50	1.226	.381	-.114				
55	-----	-----	-----	55	1.165	.431	-.091				
60	.994	-.169	-.194	$C_{T,s} = 0.80$							
65	-----	-----	-----	$C_{T,s} = 0.60$							
70	1.010	.018	-.200	-20	-0.025	-0.500	-0.295				
75	-----	-----	-----	-15	.217	-.520	-.284				
80	.996	.200	-.197	-10	.456	-.510	-.262				
90	.941	.376	-.191	-5	.693	-.474	-.244				
$C_{T,s} = 0.95$											
-20	0.006	-0.940	-0.183	0	.969	-.416	-.239				
-15	.141	-.953	-.171	5	1.252	-.321	-.249				
-10	.271	-.939	-.166	10	1.484	-.190	-.244				
-5	.388	-.916	-.159	15	1.711	-.045	-.253				
0	.525	-.869	-.156	20	1.878	.133	-.254				
5	.642	-.822	-.155	25	1.594	.259	-.248				
10	.756	-.753	-.151	30	1.459	.353	-.220				
15	.843	-.677	-.152	35	1.412	.465	-.214				
20	.940	-.586	-.149	$C_{T,s} = 0.30$							
25	1.011	-.498	-.151	$C_{T,s} = 0.10$							
30	1.057	-.390	-.145	-20	-0.174	-0.143	-0.284				
35	1.111	-.276	-.142	-15	.198	-.195	-.344				
40	1.152	-.169	-.141	-10	.527	-.189	-.320				
45	1.178	-.045	-.143	-5	.834	-.138	-.307				
50	1.190	.065	-.148	0	1.179	-.061	-.304				
55	1.183	.171	-.141	5	1.503	.045	-.303				
60	1.143	.260	-.137	10	1.827	.197	-.309				
65	1.115	.354	-.121	15	2.137	.366	-.314				
$C_{T,s} = 0.90$											
-20	0.023	-0.881	-0.209	20	2.454	.577	-.336				
-15	.185	-.895	-.199	25	1.829	.691	-.299				
-10	.343	-.877	-.191	30	1.566	.737	-.267				
-5	.485	-.852	-.183	$C_{T,s} = 0$							
0	.628	-.807	-.179	$C_{T,s} = -0.10$							
5	.780	-.736	-.178	-20	-0.330	0.207	-0.253				
10	.924	-.650	-.170	-15	.173	.115	-.381				
15	1.023	-.556	-.173	-10	.557	.125	-.368				
20	1.111	-.423	-.169	-5	.935	.170	-.349				
25	1.171	-.330	-.169	0	1.329	.258	-.342				
30	1.229	-.206	-.167	5	1.718	.391	-.343				
35	1.284	-.080	-.175	10	2.141	.545	-.358				
40	1.309	.045	-.169	15	2.477	.716	-.349				
45	1.311	.164	-.157	20	2.689	.946	-.360				
50	1.286	.262	-.147	25	1.837	.938	-.325				
55	1.236	.332	-.131	30	1.519	1.000	-.301				
60	1.168	.364	-.095								

TABLE 4.- TABULATED AERODYNAMIC DATA FOR $\delta_F = 50^\circ$, $\delta_n = 0^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$				$C_{T,s} = 0.80$			
-20	-----	-----	-----	-20	0.151	-0.733	-0.261
-15	-----	-----	-----	-15	.333	-.725	-.249
-10	-----	-----	-----	-10	.536	-.702	-.241
-5	-----	-----	-----	-5	.719	-.659	-.235
0	0.432	-0.906	-0.153	0	.922	-.588	-.232
5	.525	-.865	-.159	5	1.100	-.503	-.230
10	.604	-.819	-.157	10	1.274	-.383	-.238
15	.649	-.773	-.161	15	1.379	-.272	-.235
20	.710	-.709	-.162	20	1.421	-.100	-.250
25	-----	-----	-----	25	1.414	.029	-.238
30	.794	-.594	-.171	30	1.415	.152	-.228
35	-----	-----	-----	35	1.386	.240	-.212
40	.881	-.434	-.180	40	1.315	.303	-.181
45	-----	-----	-----	45	1.259	.364	-.159
50	.948	-.284	-.198	50	1.176	.419	-.118
55	-----	-----	-----	$C_{T,s} = 0.60$			
60	.985	-.113	-.206	-20	0.105	-0.471	-0.304
65	-----	-----	-----	-15	.342	-.479	-.296
70	.995	.066	-.213	-10	.577	-.455	-.278
75	-----	-----	-----	-5	.833	-.410	-.265
80	.966	.243	-.211	0	1.129	-.323	-.273
90	.906	.418	-.210	5	1.416	-.215	-.287
$C_{T,s} = 0.95$				10	1.643	-.070	-.288
-20	0.088	-0.936	-0.192	15	1.804	.057	-.285
-15	.223	-.927	-.195	20	1.828	.251	-.263
-10	.360	-.904	-.187	25	1.582	.359	-.273
-5	.476	-.874	-.178	30	1.428	.425	-.225
0	.604	-.820	-.177	$C_{T,s} = 0.30$			
5	.715	-.758	-.176	-20	0.016	-0.139	-0.325
10	.810	-.684	-.172	-15	.360	-.158	-.347
15	.901	-.601	-.169	-10	.701	-.136	-.329
20	.980	-.515	-.173	-5	1.021	-.072	-.329
25	1.032	-.416	-.164	0	1.346	.021	-.330
30	1.098	-.301	-.164	5	1.666	.127	-.319
35	1.135	-.190	-.164	10	1.966	.275	-.310
40	1.168	-.069	-.168	15	2.210	.438	-.307
45	1.183	.049	-.166	20	2.496	.696	-.327
50	1.173	.160	-.165	25	1.748	.738	-.291
55	1.143	.251	-.156	30	1.492	.775	-.264
60	1.119	.337	-.142	$C_{T,s} = 0$			
$C_{T,s} = 0.90$				-20	-0.146	0.207	-0.310
-15	0.119	-0.860	-0.221	-15	.337	.168	-.392
-10	.277	-.874	-.219	-10	.789	.191	-.385
-5	.433	-.835	-.204	-5	1.147	.266	-.372
0	.581	-.794	-.203	0	1.556	.362	-.363
5	.738	-.735	-.199	5	1.909	.486	-.365
10	.881	-.662	-.201	10	2.279	.651	-.352
15	1.014	-.569	-.197	15	2.557	.803	-.346
20	1.100	-.475	-.194	20	2.858	1.043	-.362
25	1.173	-.352	-.189	25	1.694	.990	-.298
30	1.225	-.229	-.201	30	1.445	1.054	-.277
35	1.291	-.090	-.198				
40	1.323	.033	-.200				
45	1.333	.157	-.195				
50	1.307	.262	-.183				
55	1.255	.323	-.160				
	1.190	.378	-.134				

TABLE 5.- TABULATED AERODYNAMIC DATA FOR $\delta_f = 0^\circ$, $\delta_s = 20^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$				
$C_{T,s} = 1.00$											
-20	----	----	----	-20	-0.451	-0.710	-0.090				
-15	----	----	----	-15	-.530	-.764	-.078				
-10	----	----	----	-10	-.170	-.816	-.062				
-5	----	----	----	-5	-.005	-.832	-.046				
0	0.118	-1.060	-0.016	0	.185	-.839	-.020				
5	.223	-1.044	-.003	5	.352	-.826	-.003				
10	.328	-1.023	-.006	10	.519	-.781	.022				
15	.417	-.994	-.006	15	.670	-.729	.034				
20	.514	-.953	-.004	20	.829	-.652	.052				
25	----	----	----	25	.958	-.563	.057				
30	.656	-.853	-.012	30	1.079	-.451	.061				
35	----	----	----	35	1.176	-.344	.070				
40	.773	-.735	-.037	40	1.266	-.218	.074				
45	----	----	----	45	1.254	-.092	.063				
50	.870	-.589	-.050	50	1.271	.059	.055				
55	----	----	----	55	1.263	.179	.057				
60	.946	-.420	-.048	60	1.240	.280	.065				
65	----	----	----	65	1.200	.374	.075				
70	1.030	-.273	-.074	$C_{T,s} = 0.80$							
75	----	----	----	-20	-0.509	-0.430	-0.012				
80	1.065	-.080	-.078	-15	-.363	-.485	-.010				
90	1.044	.115	-.067	-10	-.203	-.546	-.008				
$C_{T,s} = 0.95$											
-20	-0.360	-0.941	-0.067	-5	-.042	-.576	-.007				
-15	-.241	-.976	-.054	0	.201	-.606	-.004				
-10	-.114	-1.004	-.035	5	.405	-.588	-.001				
-5	.010	-.1.016	-.023	10	.627	-.545	.002				
0	.146	-.1.015	-.009	15	.828	-.484	.005				
5	.259	-.997	.002	20	1.029	-.393	.006				
10	.384	-.966	.004	25	1.156	-.282	.007				
15	.495	-.927	.015	30	1.317	-.151	.008				
20	.620	-.867	.020	35	1.442	-.011	.008				
25	.720	-.811	.022	40	1.547	.139	.008				
30	.808	-.726	.023	45	1.591	.276	.008				
35	.896	-.645	.027	50	1.414	.392	.005				
40	.963	-.558	.030	55	1.283	.476	.005				
45	1.013	-.449	.031	$C_{T,s} = 0.60$							
50	1.063	-.357	.035	-20	-0.509	-0.430	-0.012				
55	1.088	-.259	.040	-15	-.363	-.485	-.010				
60	1.114	-.147	.059	-10	-.203	-.546	-.008				
65	1.132	-.037	.040	-5	-.042	-.576	-.007				
70	1.132	.058	.044	0	.201	-.606	-.004				
75	1.127	.163	.054	5	.405	-.588	-.001				
80	1.109	.255	.055	10	1.029	-.393	.006				
$C_{T,s} = 0.90$											
-20	-0.435	-0.842	-0.071	15	-.147	-.113	-0.127				
-15	-.314	-.893	-.060	20	-.209	-.209	-.095				
-10	-.147	-.931	-.043	25	-.256	-.278	-.079				
-5	.009	-.953	-.033	30	-.298	-.265	-.060				
0	.170	-.951	-.012	35	-.340	-.221	-.032				
5	.305	-.935	.007	40	-.382	-.148	.008				
10	.436	-.900	.016	45	-.424	-.046	.073				
15	.562	-.855	.031	50	1.250	.081	.085				
20	.691	-.794	.040	15	1.384	.224	.096				
25	.803	-.716	.041	20	1.552	.371	.101				
30	.912	-.633	.048	25	1.676	.542	.091				
35	1.003	-.533	.052	30	1.732	.681	.083				
40	1.067	-.418	.046	35	1.719	.590	.037				
45	1.119	-.305	.050	$C_{T,s} = 0$							
50	1.162	-.195	.046	-20	-0.466	0.297	-0.146				
55	1.180	-.081	.052	-15	-.338	.205	-.144				
60	1.187	.022	.056	-10	-.179	.122	-.125				
65	1.172	.128	.060	-5	-.028	.091	-.101				
70	1.152	.209	.070	0	.166	.053	-.081				
75	1.118	.287	.079	5	.451	.049	-.050				

TABLE 6.- TABULATED AERODYNAMIC DATA FOR $\delta_f = 20^\circ$, $\delta_s = 20^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$			
-20	----	----	----
-15	----	----	----
-10	----	----	----
-5	----	----	----
0	0.286	-1.026	-0.090
5	.387	-.998	-.088
10	.477	-.958	-.085
15	.554	-.915	-.087
20	.623	-.851	-.092
25	----	----	----
30	.764	-.747	-.102
35	----	----	----
40	.865	-.597	-.110
45	----	----	----
50	.954	-.445	-.125
55	----	----	----
60	1.009	-.287	-.136
65	----	----	----
70	1.051	-.075	-.143
75	----	----	----
80	1.054	.104	-.143
90	1.012	.292	-.142
$C_{T,s} = 0.95$			
-20	-0.150	-0.956	-0.136
-15	-.025	-.974	-.120
-10	.111	-.983	-.110
-5	.241	-.972	-.107
0	.376	-.954	-.100
5	.494	-.926	-.093
10	.618	-.871	-.090
15	.740	-.808	-.081
20	.845	-.733	-.071
25	.921	-.651	-.069
30	.997	-.558	-.069
35	1.051	-.464	-.067
40	1.111	-.371	-.062
45	1.125	-.272	-.053
50	1.163	-.158	-.052
55	1.176	-.047	-.056
60	1.186	.061	-.049
65	1.166	.156	-.038
70	1.149	.244	-.029
75	1.118	.329	-.017
$C_{T,s} = 0.90$			
-20	-0.185	-0.880	-0.147
-15	-.035	-.917	-.145
-10	.139	-.929	-.130
-5	.297	-.930	-.122
0	.453	-.902	-.106
5	.585	-.862	-.094
10	.732	-.794	-.088
15	.849	-.727	-.074
20	.977	-.642	-.073
25	1.082	-.533	-.071
30	1.139	-.429	-.061
35	1.197	-.320	-.057
40	1.238	-.198	-.062
45	1.268	-.072	-.051
50	1.271	.027	-.048
55	1.255	.125	-.036
60	1.227	.207	-.021
65	1.181	.279	.001
70	1.146	.343	.010
75	1.101	.410	.026

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
-20	-0.240	-0.741	-0.172
-15	-.058	-.794	-.158
-10	.129	-.814	-.146
-5	.320	-.815	-.140
0	.513	-.787	-.123
5	.708	-.739	-.114
10	.912	-.659	-.102
15	1.059	-.577	-.094
20	1.212	-.461	-.079
25	1.314	-.353	-.068
30	1.415	-.216	-.068
35	1.429	-.104	-.063
40	1.422	.020	-.068
45	1.346	.125	-.048
50	1.325	.225	-.035
55	1.282	.322	-.022
60	1.243	.409	-.004
$C_{T,s} = 0.60$			
-20	-0.273	-0.459	-0.185
-15	-.150	-.509	-.168
-10	.056	-.551	-.160
-5	.293	-.563	-.154
0	.610	-.550	-.150
5	.880	-.492	-.137
10	1.155	-.391	-.126
15	1.359	-.297	-.111
20	1.518	-.165	-.092
25	1.606	-.028	-.087
30	1.670	.115	-.070
35	1.694	.255	-.065
40	1.706	.377	-.045
45	1.555	.463	-.025
50	1.419	.573	-.049
$C_{T,s} = 0.30$			
-20	-0.270	-0.118	-0.203
-15	-.168	-.166	-.171
-10	-.018	-.214	-.151
-5	.202	-.232	-.156
0	.617	-.220	-.175
5	1.040	-.156	-.182
10	1.402	-.046	-.163
15	1.677	.072	-.142
20	1.870	.223	-.115
25	1.870	.375	-.108
30	1.984	.560	-.101
35	2.054	.719	-.092
40	1.981	.820	-.071
45	1.889	.907	-.049
$C_{T,s} = 0$			
-20	-0.244	0.239	-0.225
-15	-.151	.193	-.193
-10	-.017	.120	-.167
-5	.155	.109	-.146
0	.561	.109	-.175
5	1.165	.173	-.199
10	1.593	.298	-.197
15	1.958	.431	-.180
20	2.236	.614	-.162
25	2.233	.779	-.131
30	2.287	.950	-.140
35	2.172	1.046	-.125
40	1.855	1.073	-.133

TABLE 7.- TABULATED AERODYNAMIC DATA FOR $\delta_f = 40^\circ$, $\delta_s = 20^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$						$C_{T,s} = 0.80$	
-20	-----	-----	-----	-20	-0.101	-0.713	-0.219
-15	-----	-----	-----	-15	.085	-.745	-.210
-10	-----	-----	-----	-10	.305	-.745	-.213
-5	-----	-----	-----	-5	.496	-.727	-.210
0	0.374	-0.948	-0.145	0	.718	-.677	-.204
5	.462	-.910	-.143	5	.973	-.598	-.213
10	.548	-.865	-.143	10	1.159	-.493	-.209
15	.608	-.817	-.152	15	1.308	-.386	-.210
20	.663	-.758	-.152	20	1.506	-.184	-.216
25	-----	-----	-----	25	1.575	-.075	-.203
30	.790	-.633	-.160	30	1.580	.049	-.194
35	-----	-----	-----	35	1.559	.151	-.168
40	.870	-.524	-.175	40	1.438	.240	-.165
45	-----	-----	-----	45	1.383	.323	-.141
50	.949	-.338	-.184	50	1.314	.385	-.103
55	-----	-----	-----	55	1.262	.461	-.082
60	1.020	-.150	-.195				
65	-----	-----	-----	$C_{T,s} = 0.60$			
70	1.008	.012	-.201	-20	-0.225	-0.429	-0.219
75	-----	-----	-----	-15	-.018	-.472	-.222
80	1.000	.200	-.197	-10	.225	-.503	-.216
90	.936	.366	-.198	-5	.485	-.488	-.213
$C_{T,s} = 0.95$						0	.821
-20	-0.012	-0.932	-0.182	5	.441	-.219	
-15	.121	-.943	-.177	10	1.169	-.331	-.243
-10	.259	-.934	-.177	15	1.474	-.207	-.245
-5	.381	-.911	-.168	20	1.688	-.058	-.237
0	.517	-.874	-.169	25	1.873	.117	-.240
5	.648	-.818	-.164	30	1.964	.278	-.220
10	.771	-.755	-.167	35	1.962	.412	-.193
15	.861	-.676	-.167	40	1.850	.498	-.166
20	.958	-.587	-.163		1.764	.567	-.121
25	1.044	-.488	-.159	$C_{T,s} = 0.30$			
30	1.084	-.389	-.154	-20	-0.273	-0.080	-0.214
35	1.139	-.282	-.154	-15	-.093	-.130	-.214
40	1.200	-.146	-.155	-10	.130	-.158	-.218
45	1.211	-.042	-.151	-5	.419	-.156	-.211
50	1.204	.054	-.146	0	.876	-.111	-.240
55	1.191	.159	-.136	5	1.398	.013	-.299
60	1.174	.244	-.127	10	1.825	.187	-.309
65	1.144	.334	-.114	15	2.084	.354	-.306
70	1.113	.409	-.100	20	2.338	.565	-.296
$C_{T,s} = 0.90$						25	2.225
-20	-0.044	-0.853	-0.203	30	2.255	.722	-.277
-15	.122	-.872	-.190	35	2.141	.858	-.248
-10	.298	-.870	-.195	$C_{T,s} = 0$			
-5	.449	-.848	-.187	-20	-0.209	0.286	-0.256
0	.617	-.795	-.194	-15	-.059	.241	-.253
5	.775	-.732	-.191	-10	.149	.189	-.237
10	.911	-.654	-.174	-5	.411	.178	-.243
15	1.033	-.567	-.179	0	.951	.235	-.281
20	1.157	-.448	-.172	5	1.565	.352	-.344
25	1.275	-.307	-.190	10	2.081	.545	-.363
30	1.308	-.203	-.177	15	2.400	.730	-.345
35	1.318	-.092	-.166	20	2.682	.943	-.332
40	1.337	.035	-.166	25	2.547	1.107	-.321
45	1.317	.128	-.142	30	2.498	1.244	-.274
50	1.292	.215	-.126				
55	1.253	.300	-.103				
60	1.208	.360	-.088				

TABLE 8.- TABULATED AERODYNAMIC DATA FOR $\delta_f = 50^\circ$, $\delta_s = 20^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{M,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{M,s}$
$C_{T,s} = 1.00$							
-20	----	----	----	-20	-0.022	-0.678	-0.222
-15	----	----	----	-15	.165	-.698	-.217
-10	----	----	----	-10	.369	-.694	-.213
-5	----	----	----	-5	.567	-.668	-.210
0	0.399	-0.917	-0.156	0	.807	-.602	-.209
5	.527	-.870	-.160	5	1.035	-.514	-.222
10	.608	-.822	-.164	10	1.215	-.408	-.221
15	.628	-.773	-.166	15	1.356	-.288	-.221
20	.700	-.725	-.165	20	1.491	-.140	-.205
25	----	----	----	25	1.575	.007	-.208
30	.785	-.598	-.179	30	1.606	.161	-.206
35	----	----	----	35	1.553	.245	-.182
40	.871	-.444	-.187	40	1.383	.302	-.166
45	----	----	----	45	1.315	.363	-.126
50	.944	.286	-.198	50	1.239	.401	-.102
55	----	----	----				
60	.987	-.119	-.209				
65	----	----	----				
70	.985	.057	-.214				
75	----	----	----				
80	.953	.232	-.206				
90	.903	.410	-.206				
$C_{T,s} = 0.95$							
-20	0.064	-0.909	-0.196	-20	-0.125	-0.410	-0.235
-15	.189	-.904	-.196	-15	.089	-.444	-.237
-10	.321	-.890	-.191	-10	.333	-.457	-.230
-5	.450	-.867	-.181	-5	.596	-.435	-.232
0	.587	-.817	-.183	0	.951	-.365	-.243
5	.698	-.760	-.179	5	1.316	-.241	-.270
10	.810	-.687	-.176	10	1.618	-.080	-.280
15	.889	-.614	-.170	15	1.786	.044	-.266
20	.981	-.513	-.174	20	1.948	.213	-.247
25	1.046	-.428	-.167	25	2.065	.409	-.254
30	1.087	-.324	-.167	30	1.975	.517	-.196
35	1.137	-.213	-.163	35	1.774	.541	-.158
40	1.190	-.073	-.170	40	1.672	.584	-.117
45	1.191	.043	-.165				
50	1.188	.145	-.162				
55	1.167	.240	-.154				
60	1.146	.320	-.142				
65	1.109	.400	-.127				
$C_{T,s} = 0.90$							
-20	0.024	-0.816	-0.208	-20	-0.209	-0.053	-0.242
-15	.183	-.827	-.205	-15	-.015	-.102	-.242
-10	.360	-.818	-.206	-10	.249	-.130	-.236
-5	.513	-.786	-.198	-5	.618	-.112	-.244
0	.686	-.731	-.195	0	1.081	-.024	-.278
5	.835	-.663	-.194	5	1.561	.103	-.304
10	.981	-.573	-.195	10	1.929	.278	-.296
15	1.088	-.478	-.187	15	2.170	.460	-.306
20	1.193	-.351	-.184	20	2.397	.685	-.307
25	1.265	-.241	-.188	25	2.451	.889	-.293
30	1.316	-.113	-.186	30	2.262	.933	-.219
35	1.319	.005	-.175	35	2.097	.971	-.176
40	1.310	.115	-.171				
45	1.289	.212	-.157				
50	1.248	.290	-.139				
55	1.195	.358	-.111				
60	1.143	.378	-.081				
$C_{T,s} = 0.80$							
-20	----	----	----	-20	-0.186	0.302	-0.261
-15	----	----	----	-15	-.019	.255	-.259
-10	----	----	----	-10	.244	.220	-.270
-5	----	----	----	-5	.634	.218	-.282
0	----	----	----	0	1.184	.304	-.320
5	----	----	----	5	1.769	.454	-.366
10	----	----	----	10	2.250	.636	-.361
15	----	----	----	15	2.474	.816	-.341
20	----	----	----	20	2.693	1.035	-.312
25	----	----	----	25	2.538	1.215	-.298
30	----	----	----	30	2.450	1.327	-.238
$C_{T,s} = 0$							
-20	----	----	----	-20	----	----	----
-15	----	----	----	-15	----	----	----
-10	----	----	----	-10	----	----	----
-5	----	----	----	-5	----	----	----
0	----	----	----	0	----	----	----
5	----	----	----	5	----	----	----
10	----	----	----	10	----	----	----
15	----	----	----	15	----	----	----
20	----	----	----	20	----	----	----
25	----	----	----	25	----	----	----
30	----	----	----	30	----	----	----

TABLE 9.- TABULATED AERODYNAMIC DATA FOR $\delta_T = 40^\circ$, $\delta_S = 20^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$							
-20	----	----	----	-20	-0.317	-0.639	-0.126
-15	----	----	----	-15	.130	.691	.128
-10	----	----	----	-10	.113	.717	.142
-5	----	----	----	-5	.346	.708	.161
0	0.285	-0.929	-0.121	0	.599	.672	.171
5	.372	-.905	-.119	5	.859	.594	.196
10	.453	-.867	-.112	10	1.089	.493	.192
15	.522	-.827	-.116	15	1.302	.360	.229
20	.592	-.774	-.118	20	1.444	.216	.225
25	----	----	----	25	1.544	.074	.210
30	.705	-.663	-.123	30	1.577	.058	.200
35	----	----	----	35	1.568	.168	.180
40	.795	-.538	-.134	40	1.429	.239	.172
45	----	----	----	45	1.369	.522	.158
50	.869	-.404	-.162	50	1.301	.371	.103
55	----	----	----	55	1.235	.433	-.086
60	.912	-.243	-.163				
65	----	----	----				
70	.968	-.058	-.162				
75	----	----	----				
80	.962	.109	-.171				
90	.924	.270	-.163				
$C_{T,s} = 0.95$							
-20	-0.159	-0.888	-0.144	-20	-0.406	-0.365	-0.128
-15	-.012	-.916	-.149	-15	-.259	-.415	-.124
-10	.148	-.913	-.139	-10	-.022	-.455	-.135
-5	.286	-.907	-.147	-5	.271	-.473	-.154
0	.415	-.884	-.158	0	.668	-.435	-.192
5	.541	-.841	-.137	5	1.070	-.333	-.226
10	.681	-.779	-.140	10	1.453	-.187	-.260
15	.780	-.719	-.134	15	1.673	-.039	-.260
20	.884	-.634	-.133	20	1.855	.120	-.242
25	.951	-.533	-.130	25	1.945	.285	-.243
30	1.060	-.429	-.126	30	1.916	.399	-.205
35	1.081	-.319	-.126	35	1.803	.475	-.174
40	1.121	-.213	-.125	40	1.718	.542	-.120
45	1.162	-.096	-.118				
50	1.178	.013	-.118				
55	1.207	.125	-.117				
60	1.174	.203	-.103				
65	1.152	.290	-.092				
70	1.126	.366	-.082				
$C_{T,s} = 0.90$							
-20	-0.204	-0.785	-0.134	-20	-0.422	-0.024	-0.111
-15	-.044	-.825	-.133	-15	-.298	-.086	-.114
-10	.133	-.828	-.155	-10	-.117	-.131	-.111
-5	.324	-.827	-.151	-5	.185	-.149	-.144
0	.501	-.790	-.156	0	.678	-.115	-.192
5	.666	-.742	-.157	5	1.286	.006	-.287
10	.820	-.659	-.156	10	1.769	.177	-.305
15	.948	-.583	-.158	15	2.067	.348	-.307
20	1.080	-.468	-.157	20	2.323	.567	-.295
25	1.212	-.333	-.167	25	2.279	.733	-.273
30	1.251	-.218	-.169	30	2.232	.856	-.236
35	1.289	-.090	-.169	35	2.128	.925	-.180
40	1.306	.019	-.160	40	1.977	.966	-.119
45	1.292	.121	-.146				
50	1.268	.206	-.130				
55	1.232	.272	-.112				
60	1.191	.333	-.083				
65	1.156	.386	-.015				
$C_{T,s} = 0.80$							
-20	----	----	----	-20	-0.365	0.337	-0.142
-15	----	----	----	-15	-.291	.267	-.128
-10	----	----	----	-10	-.152	.186	-.119
-5	----	----	----	-5	.111	.170	-.138
0	----	----	----	0	.665	.201	-.202
5	----	----	----	5	1.453	.358	-.326
10	----	----	----	10	2.070	.549	-.364
15	----	----	----	15	2.392	.719	-.350
20	----	----	----	20	2.677	.940	-.335
25	----	----	----	25	2.579	1.139	-.315
30	----	----	----	30	2.492	1.252	-.252
$C_{T,s} = 0.60$							
-20	----	----	----	-20	----	----	----
-15	----	----	----	-15	----	----	----
-10	----	----	----	-10	----	----	----
-5	----	----	----	-5	----	----	----
0	----	----	----	0	----	----	----
5	----	----	----	5	----	----	----
10	----	----	----	10	----	----	----
15	----	----	----	15	----	----	----
20	----	----	----	20	----	----	----
25	----	----	----	25	----	----	----
30	----	----	----	30	----	----	----
40	----	----	----	40	----	----	----

TABLE 10.- TABULATED AERODYNAMIC DATA FOR $\delta_f = 50^\circ$, $\delta_s = 20^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$							
-20	---	---	---	-20	-0.270	-0.637	-0.143
-15	---	---	---	-15	-.077	-.678	-.138
-10	---	---	---	-10	.173	-.694	-.155
-5	---	---	---	-5	.420	-.672	-.175
0	0.299	-0.912	-0.124	0	.666	-.621	-.184
5	.381	-.884	-.121	5	.926	-.538	-.198
10	.463	-.847	-.119	10	1.147	-.425	-.208
15	.538	-.804	-.129	15	1.337	-.294	-.224
20	.595	-.752	-.123	20	1.472	-.149	-.218
25	---	---	---	25	1.588	.011	-.221
30	.710	-.645	-.140	30	1.570	.146	-.214
35	---	---	---	35	1.543	.239	-.181
40	.801	-.494	-.146	40	1.388	.291	-.162
45	---	---	---	45	1.305	.339	-.124
50	.878	-.366	-.157	50	1.233	.383	-.095
55	---	---	---				
60	.925	-.200	-.166				
65	---	---	---				
70	.957	-.021	-.172				
75	---	---	---				
80	.944	.149	-.173				
90	.905	.294	-.176				
$C_{T,s} = 0.95$							
-20	-0.101	-0.854	-0.152	-20	-0.416	-0.346	-0.110
-15	.040	-.869	-.155	-15	-.216	-.405	-.153
-10	.194	-.872	-.151	-10	.087	-.444	-.149
-5	.326	-.859	-.158	-5	.412	-.438	-.175
0	.455	-.832	-.155	0	.796	-.384	-.206
5	.579	-.785	-.149	5	1.206	-.252	-.252
10	.693	-.719	-.146	10	1.540	-.093	-.271
15	.783	-.659	-.140	15	1.729	.039	-.259
20	.880	-.576	-.138	20	1.894	.203	-.250
25	.961	-.476	-.138	25	2.023	.404	-.251
30	1.036	-.384	-.141	30	1.949	.501	-.203
35	1.074	-.265	-.139	35	1.742	.520	-.155
40	1.114	-.153	-.139	40	1.620	.542	-.103
45	1.143	-.038	-.137				
50	1.149	.068	-.136				
55	1.138	.167	-.127				
60	1.130	.246	-.114				
65	1.096	.328	-.103				
70	1.067	.395	-.093				
$C_{T,s} = 0.90$							
-20	-0.155	-0.780	-0.151				
-15	.003	-.807	-.152				
-10	.195	-.809	-.154				
-5	.386	-.789	-.159				
0	.559	-.746	-.163				
5	.714	-.684	-.166				
10	.889	-.598	-.170				
15	1.012	-.508	-.170				
20	1.146	-.386	-.180				
25	1.250	-.258	-.183				
30	1.269	-.155	-.168				
35	1.287	-.040	-.160				
40	1.279	.063	-.150				
45	1.270	.162	-.134				
50	1.233	.229	-.121				
55	1.193	.290	-.098				
60	1.146	.340	-.070				
65	1.094	.390	-.054				
$C_{T,s} = 0.80$							
-20	---	---	---				
-15	---	---	---				
-10	---	---	---				
-5	---	---	---				
0	---	---	---				
5	---	---	---				
10	---	---	---				
15	---	---	---				
20	---	---	---				
25	---	---	---				
30	---	---	---				
35	---	---	---				
40	---	---	---				
45	---	---	---				
50	---	---	---				
55	---	---	---				
60	---	---	---				
65	---	---	---				
$C_{T,s} = 0.60$							
-20	---	---	---				
-15	---	---	---				
-10	---	---	---				
-5	---	---	---				
0	---	---	---				
5	---	---	---				
10	---	---	---				
15	---	---	---				
20	---	---	---				
25	---	---	---				
30	---	---	---				
35	---	---	---				
40	---	---	---				
$C_{T,s} = 0.30$							
-20	---	---	---				
-15	---	---	---				
-10	---	---	---				
-5	---	---	---				
0	---	---	---				
5	---	---	---				
10	---	---	---				
15	---	---	---				
20	---	---	---				
25	---	---	---				
30	---	---	---				
35	---	---	---				
$C_{T,s} = 0$							
-20	---	---	---				
-15	---	---	---				
-10	---	---	---				
-5	---	---	---				
0	---	---	---				
5	---	---	---				
10	---	---	---				
15	---	---	---				
20	---	---	---				
25	---	---	---				
30	---	---	---				

TABLE 11.- TABULATED AERODYNAMIC DATA

FOR $\delta_F = 50^\circ$, $\delta_K = 40^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
-20	-0.181	-0.759	-0.137
-15	-0.017	-0.792	-0.143
-10	.197	-0.796	-0.154
-5	.376	-0.772	-0.154
0	.561	-0.734	-0.170
5	.718	-0.673	-0.169
10	.878	-0.593	-0.169
15	1.006	-0.510	-0.176
20	1.119	-0.399	-0.168
25	1.194	-0.276	-0.170
30	1.260	-0.152	-0.164
35	1.294	-0.032	-0.159
40	1.321	.086	-0.145
45	1.307	.189	-0.129
50	1.274	.267	-0.116
55	1.230	.348	-0.104
60	1.169	.398	-0.079
$C_{T,s} = 0.80$			
-20	-0.319	-0.617	-0.113
-15	-.111	-.663	-.123
-10	.138	-.677	-.139
-5	.367	-.673	-.154
0	.654	-.611	-.179
5	.928	-.522	-.198
10	1.163	-.412	-.212
15	1.349	-.279	-.232
20	1.458	-.136	-.215
25	1.436	-.009	-.217
30	1.462	.141	-.207
35	1.437	.263	-.208
40	1.376	.333	-.175
45	1.307	.384	-.135
50	1.231	.411	-.118
$C_{T,s} = 0.60$			
-20	-0.467	-0.328	-0.086
-15	-.304	-.386	-.090
-10	-.014	-.425	-.110
-5	.358	-.426	-.158
0	.769	-.371	-.198
5	1.181	-.266	-.246
10	1.519	-.106	-.254
15	1.727	.043	-.254
20	1.954	.254	-.269
25	1.764	.377	-.253
30	1.601	.446	-.204
35	1.473	.509	-.183

TABLE 12.- TABULATED AERODYNAMIC DATA

FOR $\delta_F = 50^\circ$, $\delta_K = 50^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
-20	-0.212	-0.755	-0.106
-15	-.052	-.787	-.115
-10	.146	-.795	-.125
-5	.337	-.785	-.139
0	.524	-.738	-.148
5	.688	-.670	-.154
10	.860	-.592	-.159
15	.981	-.509	-.161
20	1.101	-.405	-.164
25	1.182	-.298	-.158
30	1.227	-.167	-.158
35	1.268	-.047	-.152
40	1.305	.079	-.145
45	1.305	.182	-.134
50	1.265	.252	-.113
55	1.216	.316	-.099
60	1.153	.354	-.067
$C_{T,s} = 0.80$			
-20	-0.337	-0.602	-0.095
-15	-.139	-.656	-.096
-10	.091	-.679	-.115
-5	.346	-.675	-.137
0	.609	-.626	-.156
5	.881	-.537	-.184
10	1.133	-.412	-.208
15	1.306	-.303	-.213
20	1.454	-.151	-.210
25	1.500	-.015	-.203
30	1.457	.123	-.209
35	1.454	.234	-.170
40	1.400	.323	-.181
45	1.334	.388	-.135
50	1.244	.438	-.103
$C_{T,s} = 0.60$			
-20	-0.451	-0.333	-0.069
-15	-.302	-.393	-.078
-10	-.060	-.432	-.077
-5	.280	-.437	-.121
0	.696	-.385	-.169
5	1.112	-.268	-.222
10	1.478	-.114	-.256
15	1.705	.031	-.257
20	1.932	.232	-.265
25	1.808	.374	-.252
30	1.644	.459	-.224
35	1.496	.498	-.177

TABLE 13.- TABULATED AERODYNAMIC DATA FOR $\delta_T = 50^\circ$, $\delta_K = 70^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$				
$C_{T,s} = 1.00$						$C_{T,s} = 0.80$					
-20	----	----	----	-20	-0.358	-0.592	-0.068				
-15	----	----	----	-15	-.204	-.637	-.072				
-10	----	----	----	-10	.034	-.668	-.082				
-5	----	----	----	-5	.265	-.673	-.095				
0	0.247	-0.879	-0.077	0	.501	-.658	-.111				
5	.327	-.864	-.084	5	.755	-.563	-.139				
10	.410	-.839	-.086	10	1.031	-.455	-.176				
15	.478	-.795	-.083	15	1.252	-.293	-.215				
20	.548	-.741	-.090	20	1.436	-.135	-.232				
25	----	----	----	25	1.372	-.020	-.224				
30	.650	-.659	-.098	30	1.401	.120	-.226				
35	----	----	----	35	1.397	.231	-.214				
40	.750	-.518	-.107	40	1.354	.298	-.186				
45	----	----	----	45	1.278	.334	-.139				
50	.852	-.376	-.113	50	1.199	.384	-.113				
55	----	----	----	$C_{T,s} = 0.60$							
60	.890	-.235	-.118	-20	-0.428	-0.328	-0.044				
65	----	----	----	-15	-.289	-.380	-.045				
70	.912	-.064	-.126	-10	-.104	-.418	-.004				
75	----	----	----	-5	.151	-.446	-.021				
80	.903	.091	-.129	0	.554	-.408	-.119				
90	.868	.254	-.129	5	.958	-.302	-.173				
$C_{T,s} = 0.95$						10	1.374	-.142	-.235		
-20	-0.179	-0.816	-0.088	15	1.671	.026	-.267				
-15	-.056	-.837	-.090	20	1.911	.220	-.277				
-10	.080	-.848	-.092	25	1.639	.362	-.276				
-5	.222	-.839	-.098	30	1.520	.452	-.226				
0	.357	-.814	-.107	$C_{T,s} = 0.30$							
5	.490	-.770	-.118	-20	-0.344	0.025	-0.067				
10	.621	-.713	-.116	-15	-.292	-.004	-.061				
15	.718	-.648	-.115	-10	-.117	-.089	-.038				
20	.814	-.578	-.114	-5	.092	-.121	-.038				
25	.897	-.492	-.116	0	.554	-.099	-.104				
30	.978	-.392	-.116	5	1.124	.028	-.198				
35	1.034	-.270	-.126	10	1.686	.216	-.269				
40	1.090	-.147	-.130	15	2.055	.399	-.294				
45	1.120	-.034	-.125	20	2.342	.627	-.306				
50	1.132	.068	-.125	25	1.770	.716	-.297				
55	1.119	.149	-.115	30	1.511	.739	-.245				
60	1.104	.230	-.104	$C_{T,s} = 0$							
65	1.069	.296	-.092	-20	-0.269	0.362	-0.088				
70	1.041	.362	-.076	-15	-.189	.304	-.062				
$C_{T,s} = 0.90$						-10	-.093	.238	-.037		
-20	-0.248	-0.742	-0.079	-5	.057	.206	-.038				
-15	-.078	-.765	-.090	0	.526	.218	-.089				
-10	.092	-.784	-.087	5	1.242	.373	-.217				
-5	.257	-.778	-.098	10	1.912	.557	-.293				
0	.443	-.741	-.111	15	2.421	.771	-.331				
5	.614	-.683	-.133	20	2.815	1.044	-.351				
10	.807	-.595	-.143	25	1.702	.983	-.279				
15	.938	-.511	-.146	30	1.445	1.030	-.266				
20	1.069	-.397	-.155								
25	1.189	-.253	-.176								
30	1.221	-.130	-.178								
35	1.250	-.024	-.170								
40	1.263	.067	-.153								
45	1.270	.162	-.136								
50	1.229	.226	-.117								
55	1.176	.285	-.090								
60	1.124	.314	-.066								
65	1.068	.373	-.051								

TABLE 14.- TABULATED AERODYNAMIC DATA FOR $\delta_T = 50^\circ$, $\delta_K = 50^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$	α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$							
-20	-----	-----	-----	-20	-0.084	-0.671	-0.198
-15	-----	-----	-----	-15	.128	-.692	-.208
-10	-----	-----	-----	-10	.358	-.685	-.217
-5	-----	-----	-----	-5	.568	-.661	-.217
0	0.394	-0.895	-0.160	0	.791	-.600	-.214
5	.471	-.860	-.160	5	1.032	-.508	-.226
10	.560	-.811	-.163	10	1.226	-.392	-.224
15	.627	-.761	-.168	15	1.376	-.273	-.232
20	.675	-.714	-.166	20	1.462	-.145	-.219
25	-----	-----	-----	25	1.494	.013	-.220
30	.778	-.586	-.175	30	1.494	.154	-.218
35	-----	-----	-----	35	1.464	.261	-.205
40	.859	-.450	-.187	40	1.420	.352	-.183
45	-----	-----	-----	45	1.333	.410	-.143
50	.927	-.301	-.195	50	1.240	.437	-.119
55	-----	-----	-----	$C_{T,s} = 0.80$			
60	.967	-.132	-.205	$C_{T,s} = 0.60$			
65	-----	-----	-----	-20	-0.206	-0.385	-0.194
70	.972	.052	-.208	-15	.010	-.430	-.199
75	-----	-----	-----	-10	.280	-.442	-.209
80	.948	.206	-.212	-5	.567	-.427	-.223
90	.889	.381	-.201	0	.899	-.360	-.227
$C_{T,s} = 0.95$							
-20	0.046	-0.884	-0.197	5	1.258	-.253	-.257
-15	.179	-.890	-.195	10	1.577	-.090	-.269
-10	.312	-.879	-.189	15	1.772	.053	-.265
-5	.433	-.849	-.180	20	1.940	.228	-.256
0	.570	-.807	-.182	25	1.811	.383	-.253
5	.687	-.751	-.178	30	1.667	.481	-.241
10	.786	-.680	-.174	35	1.527	.528	-.195
15	.895	-.615	-.175	$C_{T,s} = 0.30$			
20	.980	-.510	-.182	-20	-0.207	-0.027	-0.181
25	1.048	-.410	-.175	-15	-.040	-.078	-.189
30	1.106	-.292	-.176	-10	.189	-.107	-.195
35	1.149	-.179	-.170	-5	.504	-.097	-.203
40	1.186	-.052	-.175	0	.985	-.030	-.247
45	1.201	.064	-.177	5	1.450	.084	-.280
50	1.195	.173	-.169	10	1.886	.251	-.294
55	1.173	.277	-.166	15	2.162	.427	-.279
60	1.145	.368	-.154	20	2.403	.667	-.287
$C_{T,s} = 0.90$							
-20	0.007	-0.819	-0.197	25	2.032	.776	-.255
-15	.206	-.828	-.211	30	1.660	.776	-.227
-10	.380	-.815	-.205	$C_{T,s} = 0$			
-5	.523	-.789	-.201	-20	-0.162	0.336	-0.207
0	.687	-.736	-.195	-15	-.008	.275	-.220
5	.840	-.659	-.196	-10	.169	.228	-.212
10	.982	-.568	-.198	-5	.562	.230	-.252
15	1.094	-.476	-.198	0	1.053	.308	-.274
20	1.186	-.366	-.182	5	1.598	.424	-.320
25	1.253	-.253	-.182	10	2.190	.631	-.354
30	1.319	-.101	-.193	15	2.523	.793	-.325
35	1.343	.020	-.186	20	2.848	1.085	-.328
40	1.351	.156	-.178	25	2.087	1.093	-.270
45	1.339	.252	-.162	30	1.691	1.082	-.248
50	1.302	.338	-.143				
55	1.230	.389	-.124				

TABLE 15.- TABULATED AERODYNAMIC DATA FOR $\delta_F = 50^\circ$, $\delta_K = 50^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
-20	0.001	-0.821	-0.199
-15	.183	-.828	-.209
-10	.365	-.819	-.209
-5	.599	-.788	-.200
0	.684	-.733	-.204
5	.844	-.663	-.202
10	.991	-.568	-.201
15	1.095	-.476	-.195
20	1.184	-.366	-.189
25	1.262	-.245	-.186
30	1.304	-.106	-.184
35	1.354	.039	-.192
40	1.355	.166	-.189
45	1.347	.274	-.169
50	1.291	.346	-.150
55	1.202	.357	-.114
60	1.128	.366	-.086
$C_{T,s} = 0.80$			
-20	-0.072	-0.674	-0.196
-15	.137	-.704	-.205
-10	.374	-.697	-.211
-5	.571	-.669	-.209
0	.805	-.602	-.210
5	1.043	-.513	-.224
10	1.238	-.405	-.225
15	1.375	-.285	-.227
20	1.493	-.140	-.215
25	1.544	.019	-.223
30	1.493	.157	-.219
35	1.453	.248	-.195
40	1.387	.319	-.179
45	1.305	.383	-.139
50	1.225	.419	-.116
$C_{T,s} = 0.60$			
-20	-0.209	-0.391	-0.188
-15	.008	-.429	-.200
-10	.277	-.442	-.211
-5	.571	-.425	-.221
0	.919	-.357	-.225
5	1.263	-.250	-.253
10	1.579	-.102	-.266
15	1.790	.062	-.269
20	1.978	.253	-.259
25	1.746	.365	-.247
30	1.596	.452	-.218
35	1.509	.531	-.176

TABLE 16.- TABULATED AERODYNAMIC DATA FOR $\delta_T = 50^\circ$, $\delta_n = 50^\circ$

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$			
-20	-----	-----	-----
-15	-----	-----	-----
-10	-----	-----	-----
-5	-----	-----	-----
0	0.422	-0.903	-0.158
5	.508	-.868	-.169
10	.592	-.815	-.168
15	.654	-.764	-.169
20	.711	-.706	-.171
25	.759	-.648	-.170
30	.786	-.583	-.177
35	.834	-.519	.183
40	.888	-.430	-.190
45	-----	-----	-----
50	.946	-.285	-.204
55	-----	-----	-----
60	.968	-.111	-.205
65	-----	-----	-----
70	.987	.079	-.217
75	-----	-----	-----
80	.954	.231	-.213
90	.895	.412	-.218
$C_{T,s} = 0.95$			
-20	0.095	-0.920	-0.210
-15	.223	-.915	-.204
-10	.354	-.897	-.198
-5	.475	-.867	-.191
0	.604	-.816	-.191
5	.715	-.756	-.187
10	.811	-.679	-.182
15	.914	-.610	-.182
20	.999	-.507	-.184
25	1.069	-.406	-.185
30	1.115	-.301	-.183
35	1.162	-.191	-.174
40	1.196	-.064	-.179
45	1.184	.032	-.177
50	1.175	.137	-.167
55	1.155	.227	-.161
60	1.119	.301	-.150
$C_{T,s} = 0.90$			
-20	0.108	-0.846	-0.229
-15	.271	-.849	-.235
-10	.432	-.829	-.217
-5	.567	-.791	-.215
0	.728	-.733	-.209
5	.878	-.663	-.213
10	1.010	-.571	-.210
15	1.121	-.478	-.206
20	1.205	-.365	-.201
25	1.274	-.252	-.200
30	1.308	-.117	-.213
35	1.313	0	-.204
40	1.323	.129	-.196
45	1.298	.227	-.181
50	1.215	.253	-.156
55	1.149	.290	-.123
60	1.093	.322	-.111

α , deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
-20	0.087	-0.707	-0.256
-15	.279	-.718	-.254
-10	.489	-.702	-.242
-5	.674	-.663	-.236
0	.893	-.596	-.237
5	1.067	-.513	-.235
10	1.240	-.401	-.234
15	1.370	-.281	-.236
20	1.472	-.124	-.240
25	1.433	.012	-.239
30	1.423	.120	-.227
35	1.355	.185	-.207
40	1.261	.237	-.172
45	1.188	.500	-.152
50	1.168	.388	-.125
$C_{T,s} = 0.60$			
-20	-0.073	-0.422	-0.237
-15	.205	-.458	-.251
-10	.501	-.451	-.259
-5	.756	-.414	-.259
0	1.082	-.339	-.268
5	1.369	-.222	-.283
10	1.628	-.078	-.287
15	1.819	.075	-.293
20	1.664	.235	-.298
25	1.535	.339	-.259
30	1.457	.408	-.223
35	1.383	.468	-.206
$C_{T,s} = 0.30$			
-20	-0.188	-0.080	-0.214
-15	.020	-.113	-.225
-10	.424	-.136	-.261
-5	.886	-.096	-.314
0	1.301	0	-.323
5	1.639	.124	-.325
10	1.959	.273	-.326
15	2.208	.438	-.327
20	1.375	.485	-.278
25	1.356	.569	-.252
$C_{T,s} = 0$			
-20	-0.164	0.273	-0.222
-15	.010	.217	-.237
-10	.322	.200	-.248
-5	.890	.247	-.324
0	1.471	.349	-.363
5	1.875	.483	-.371
10	2.271	.643	-.371
15	2.541	.825	-.375
20	1.460	.852	-.302
25	1.422	.924	-.274

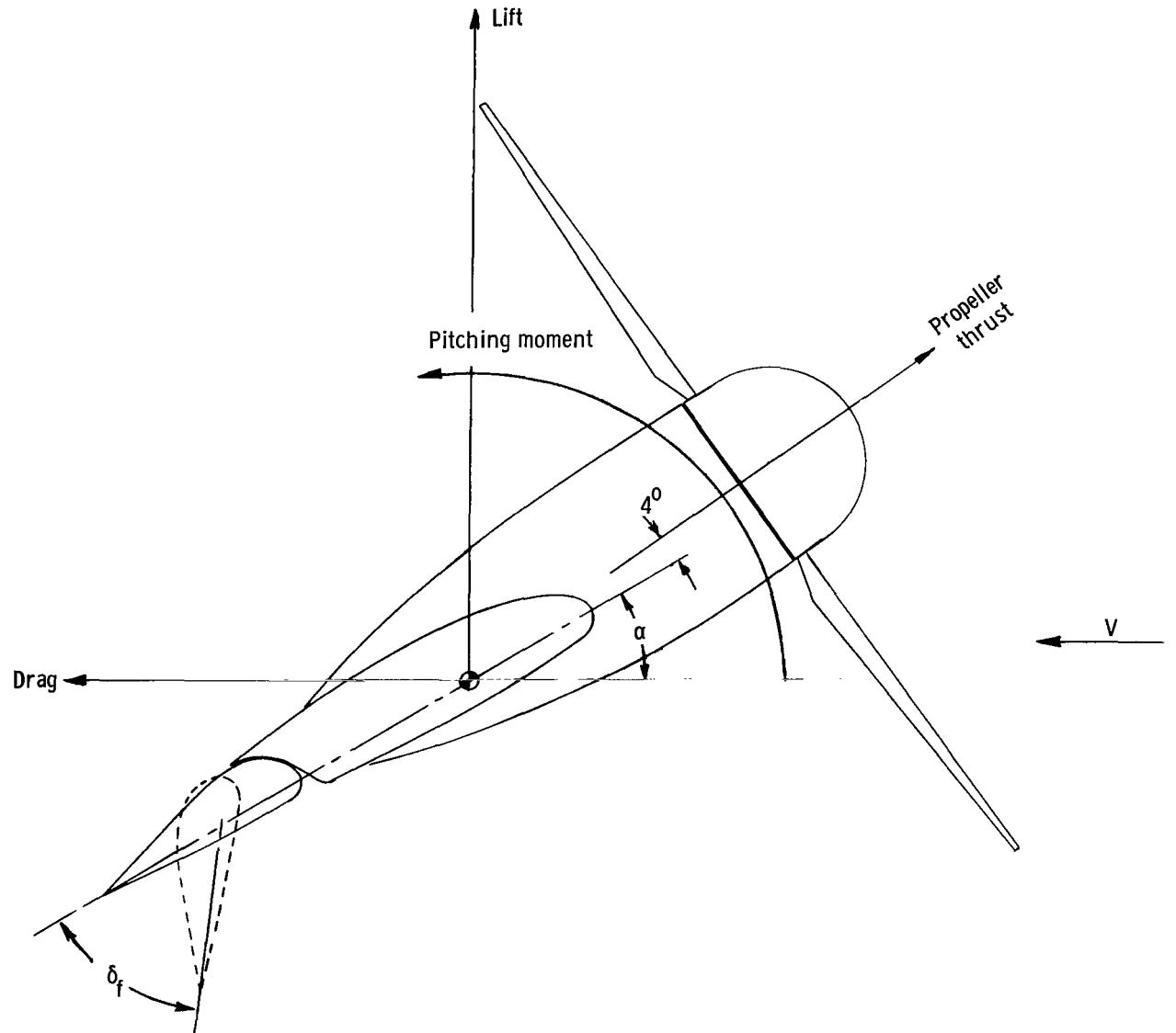
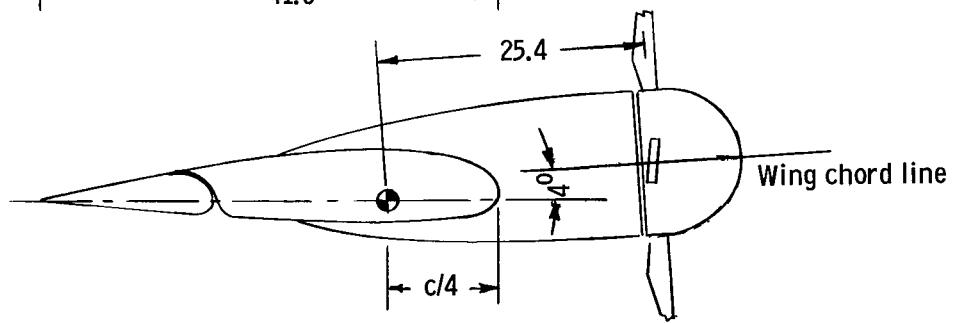
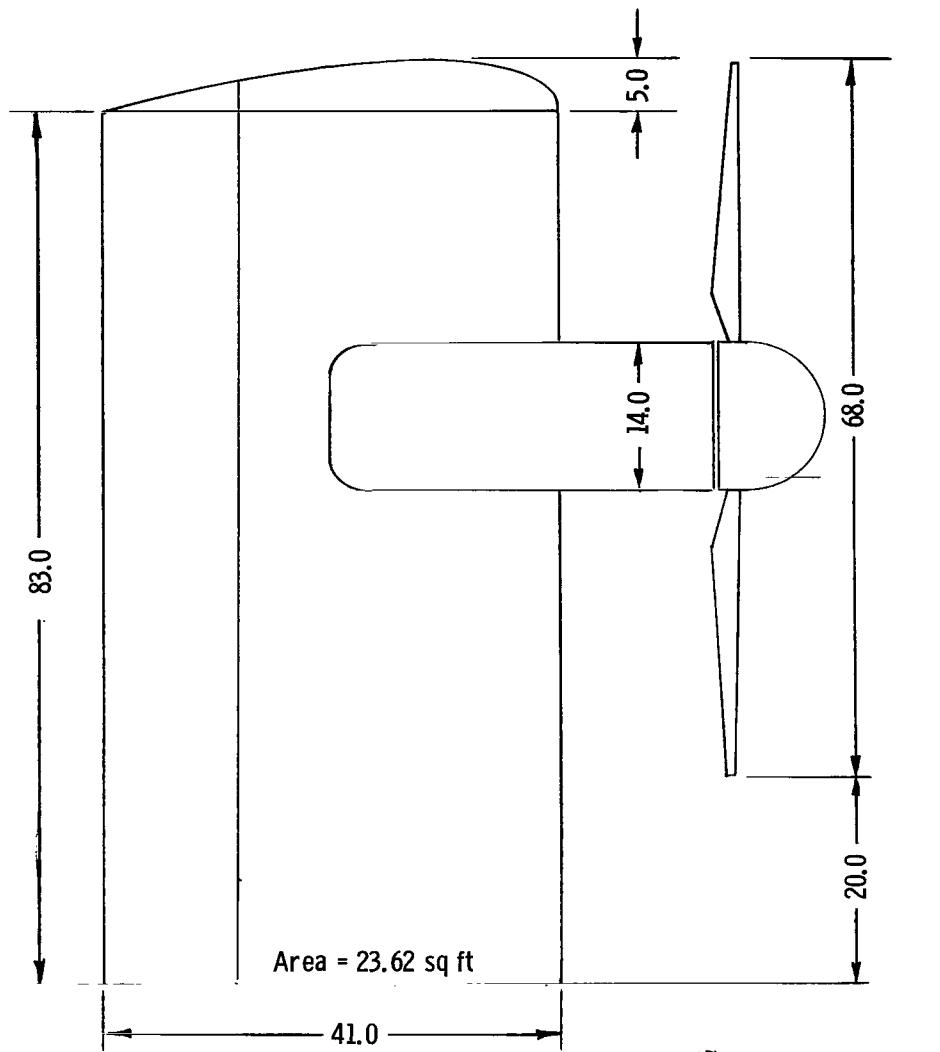
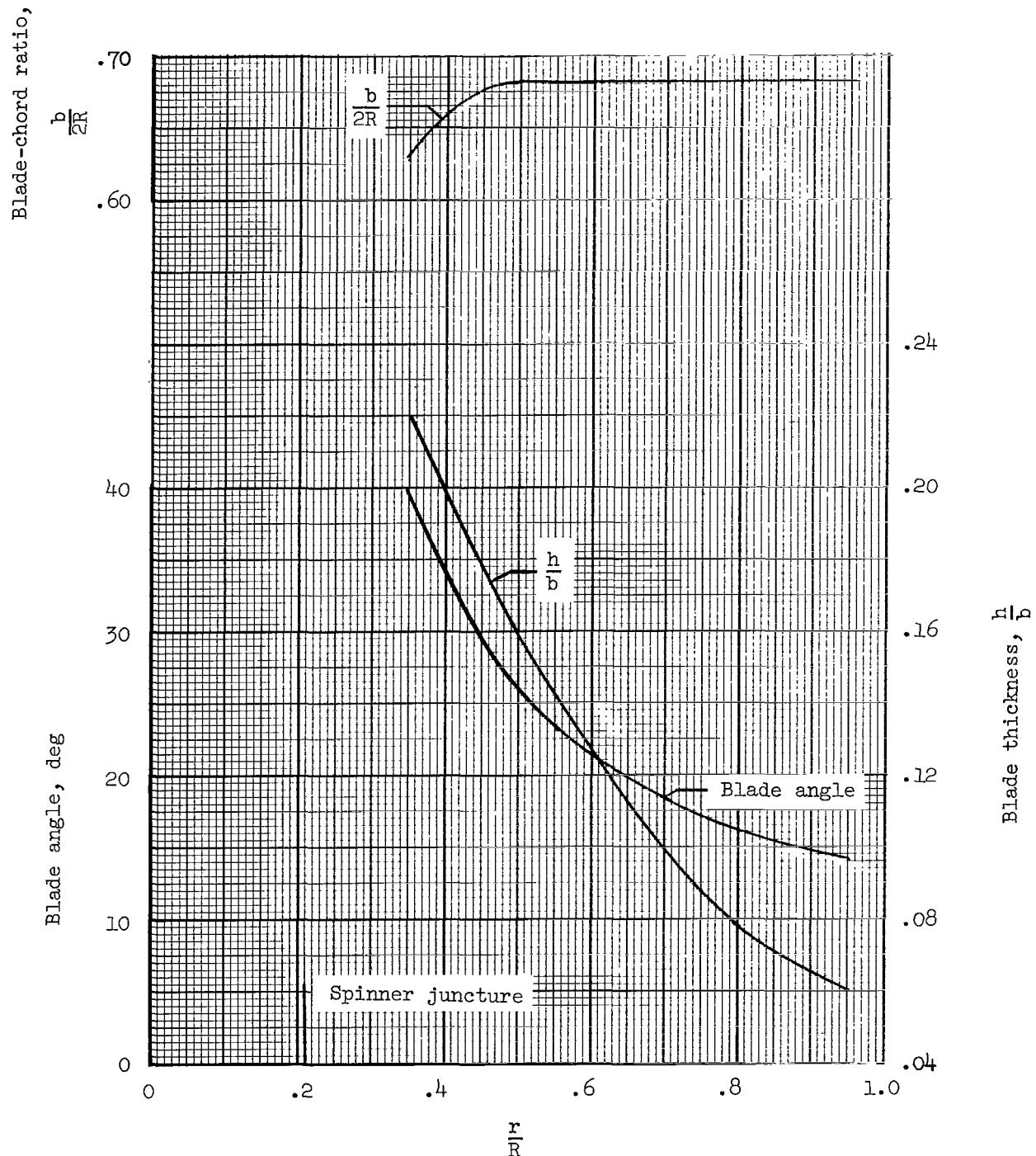


Figure 1.- The positive sense of forces, moments, and angles.



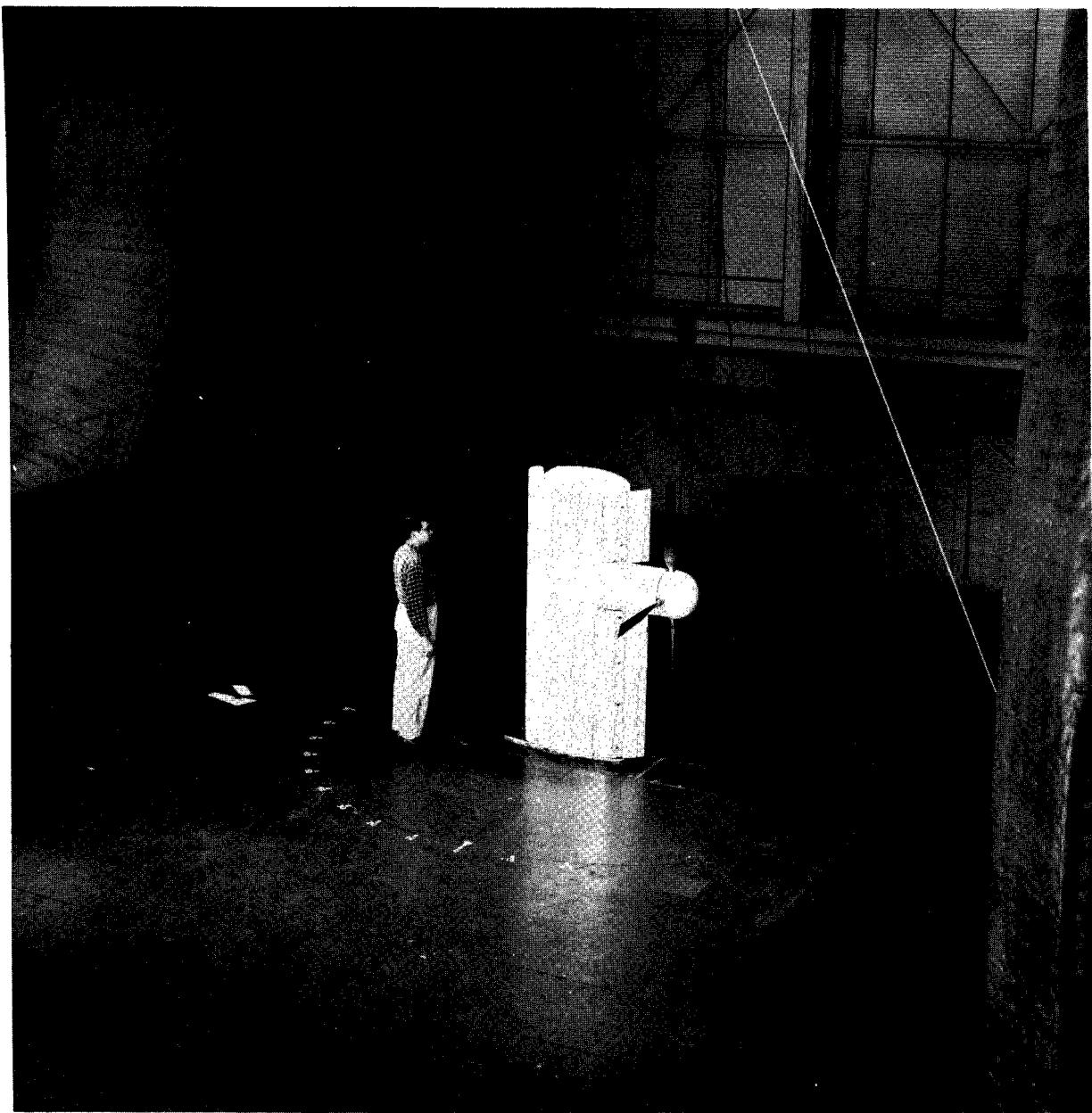
(a) Principal dimensions of model in inches.

Figure 2.- Principal dimensions of model, propeller blade form curves, and photograph showing model mounted in tunnel.



(b) Propeller blade form curves.

Figure 2.- Continued.



(c) Photograph of model in tunnel.

L-64-1759

Figure 2.- Concluded.

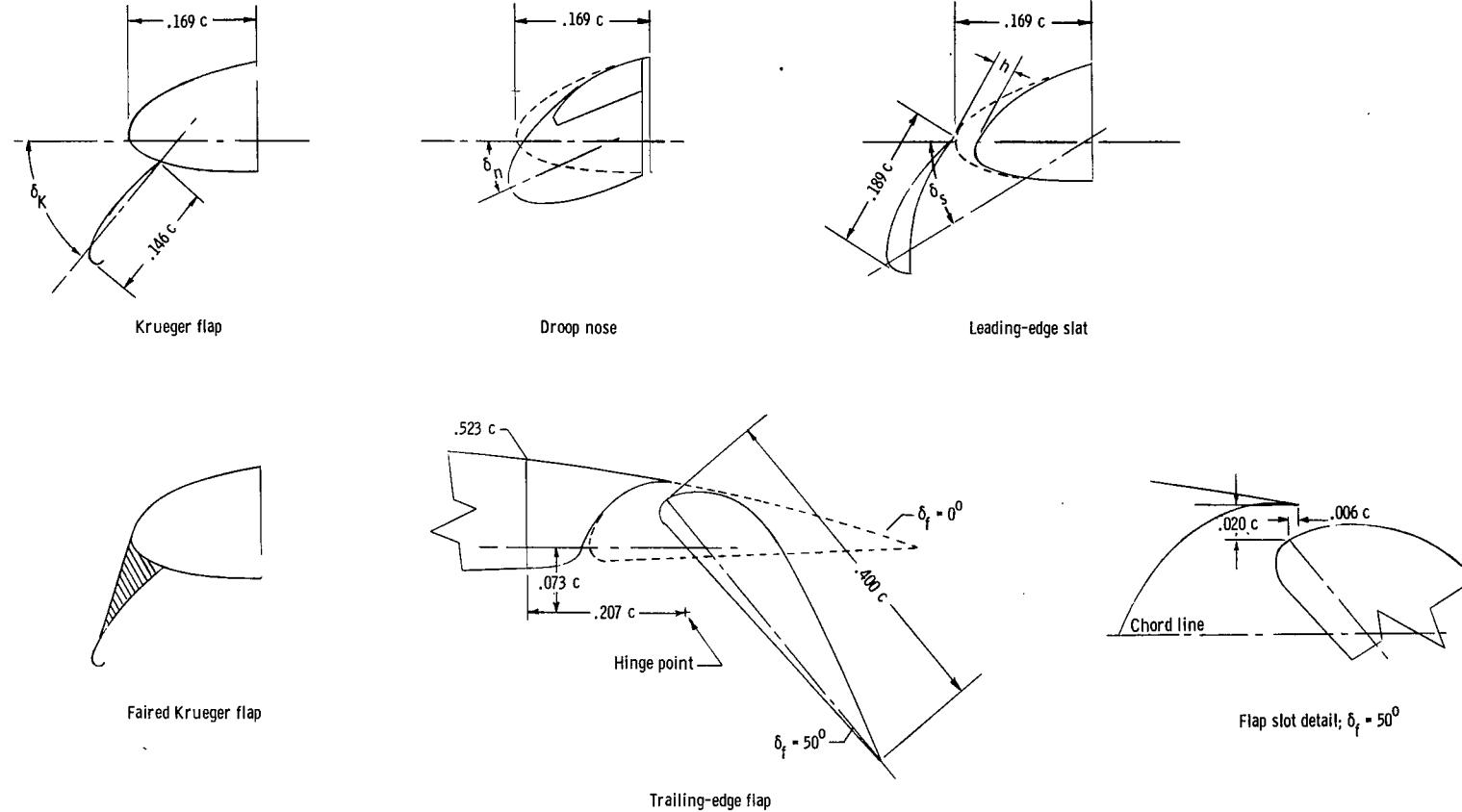
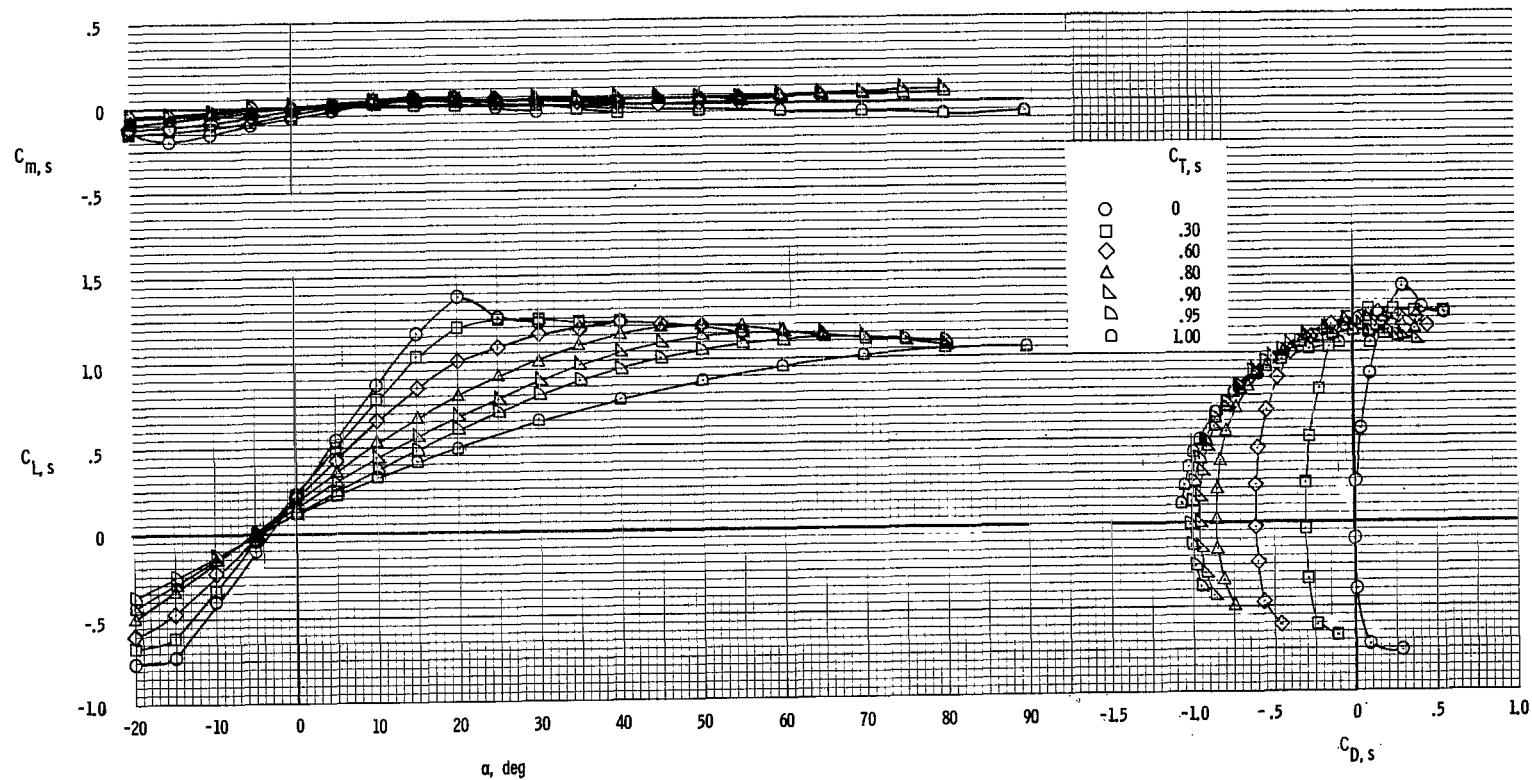
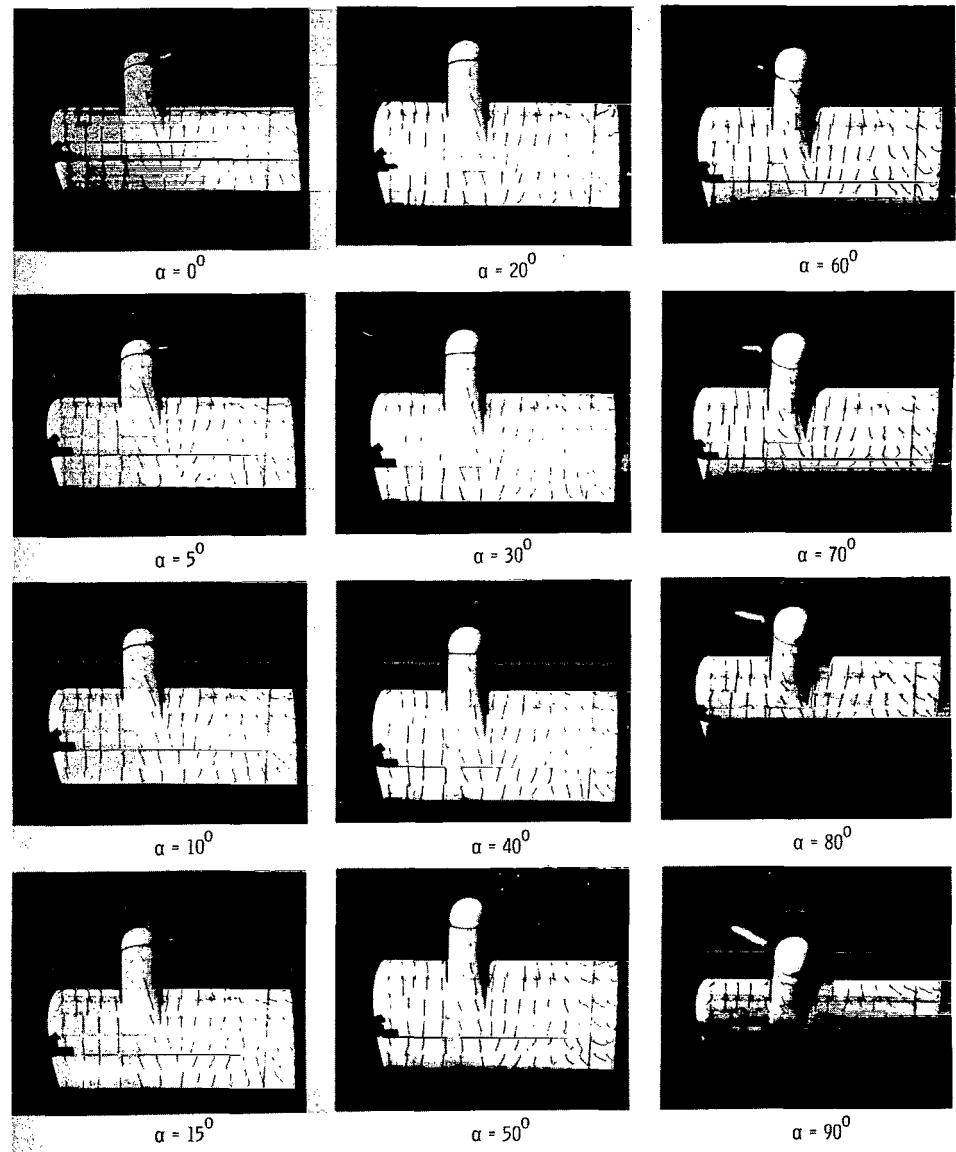


Figure 3.- Sectional views of various leading-edge devices and trailing-edge flap.



(a) Aerodynamic characteristics.

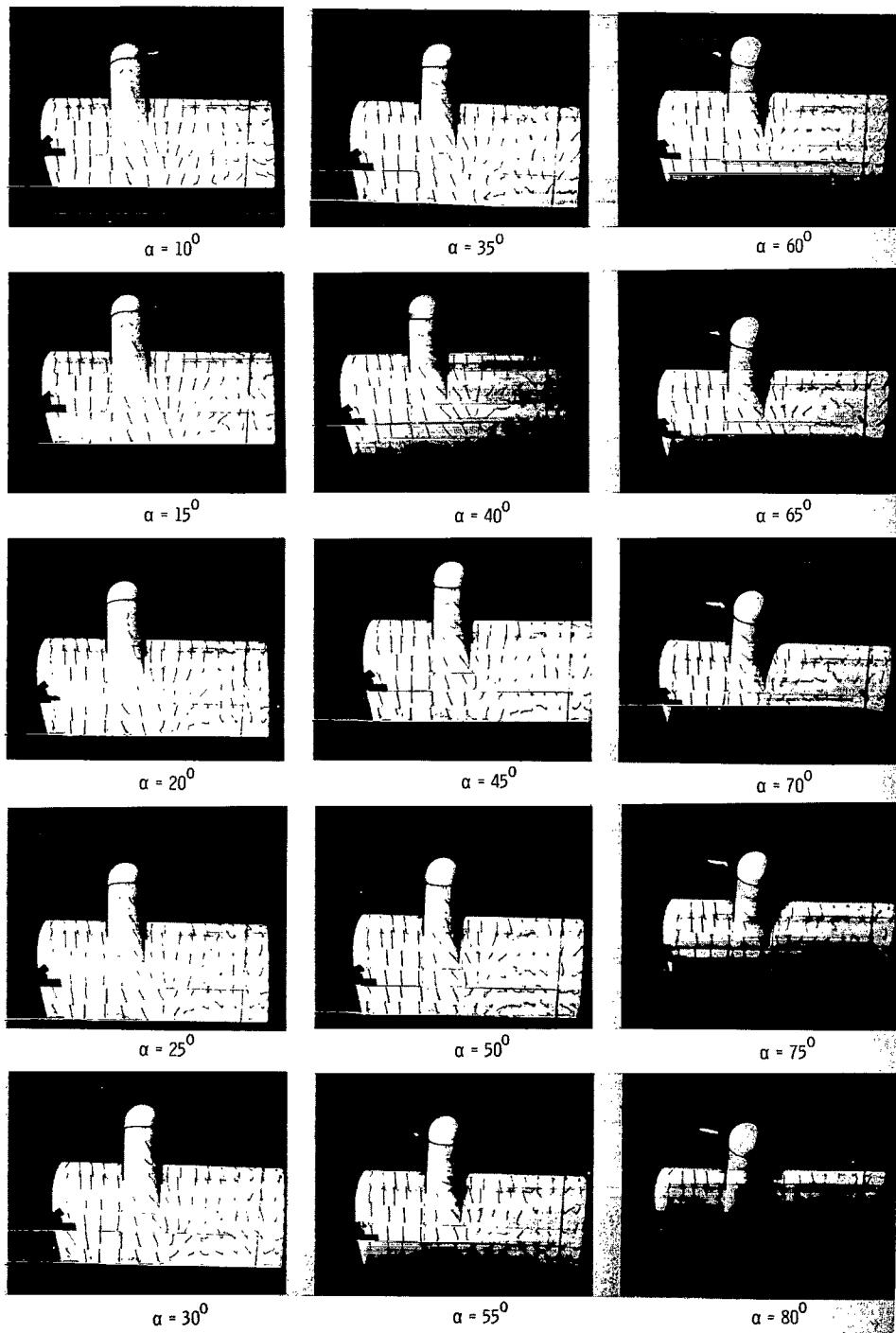
Figure 4.- Aerodynamic and flow characteristics of the model with basic leading edge and with trailing-edge flap retracted.
 $\delta_f = 0^\circ$.



(b) Flow characteristics; $C_{T,s} = 1.00$.

L-64-4401

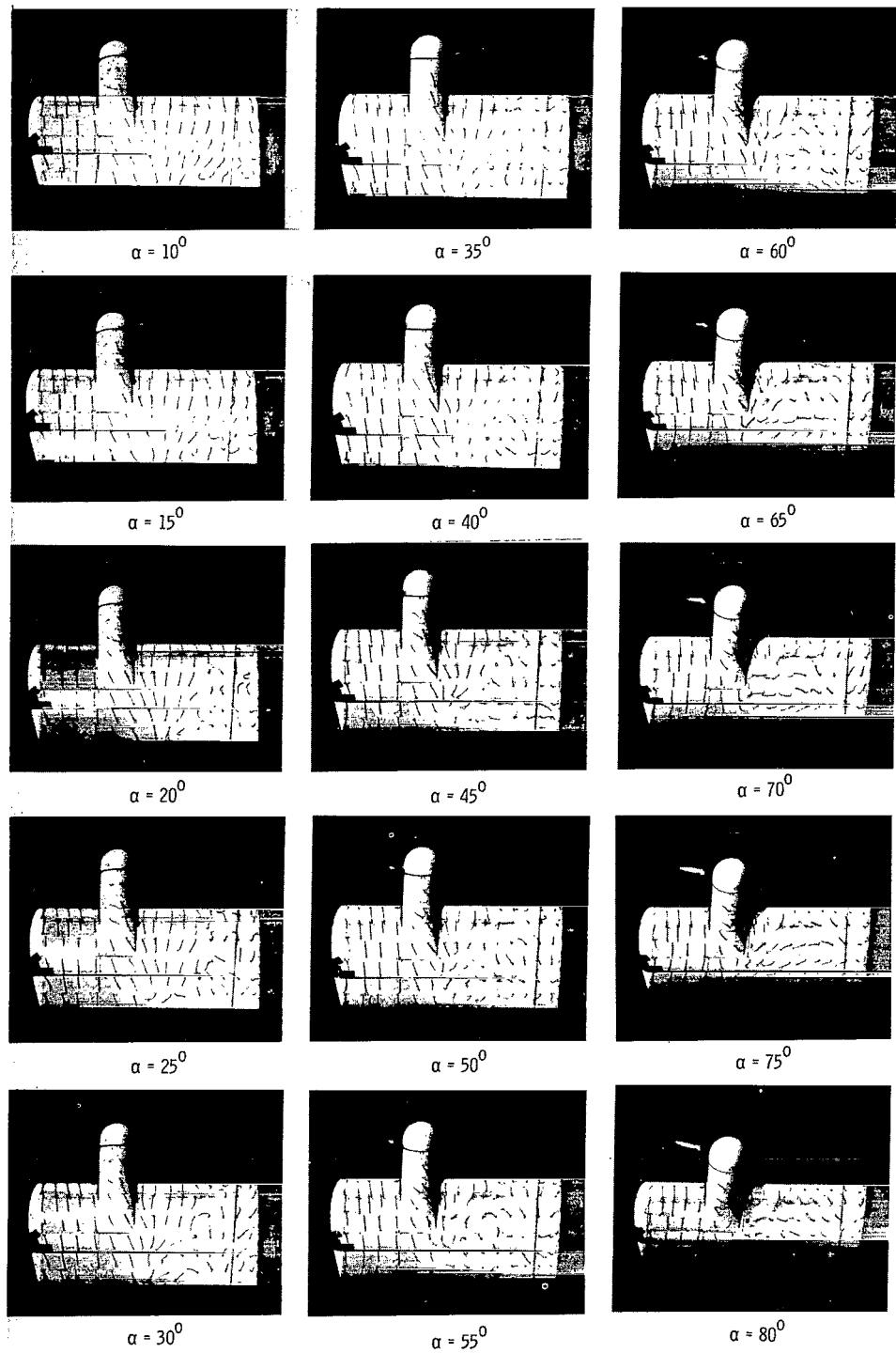
Figure 4.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95.$

L-64-4402

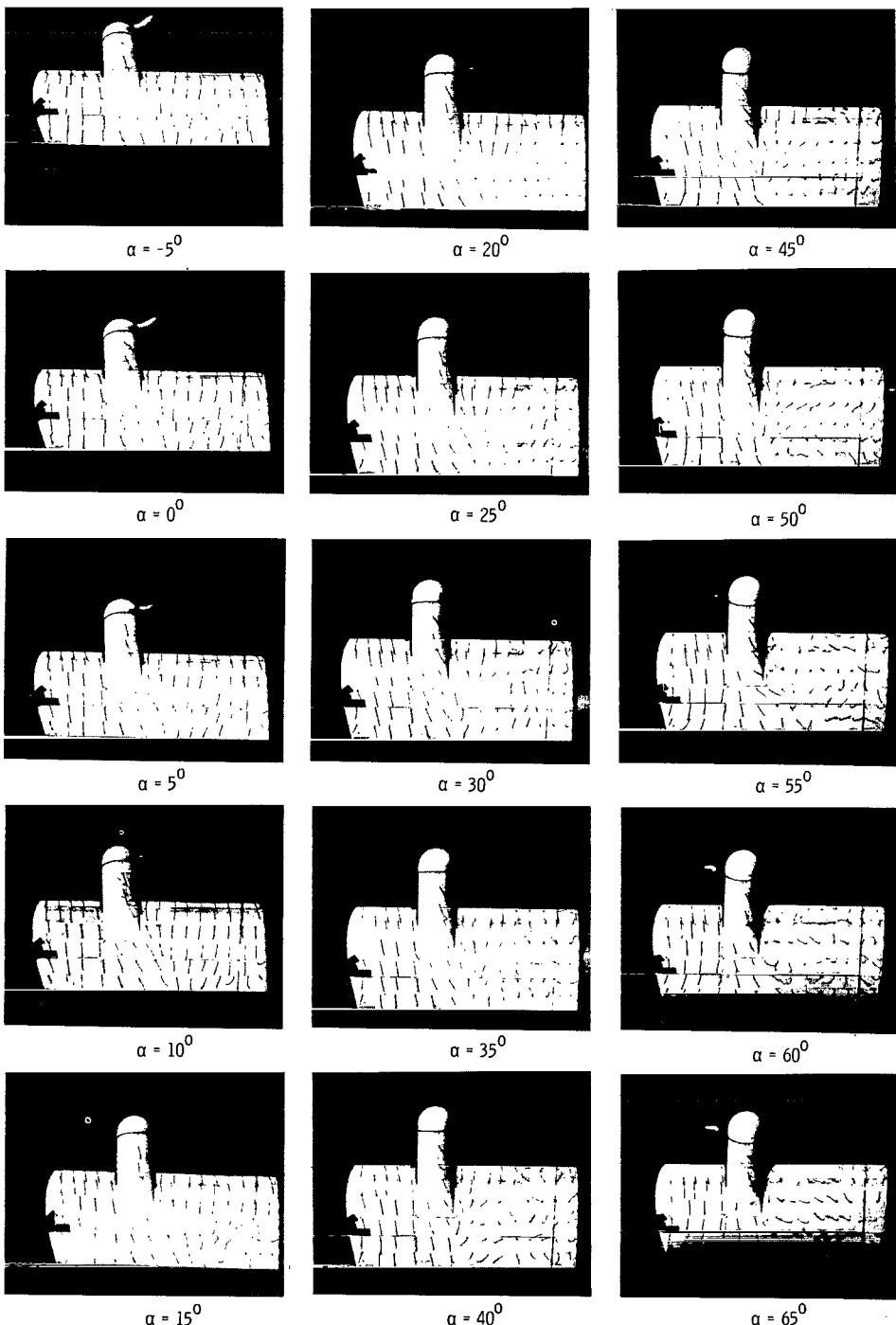
Figure 4.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4403

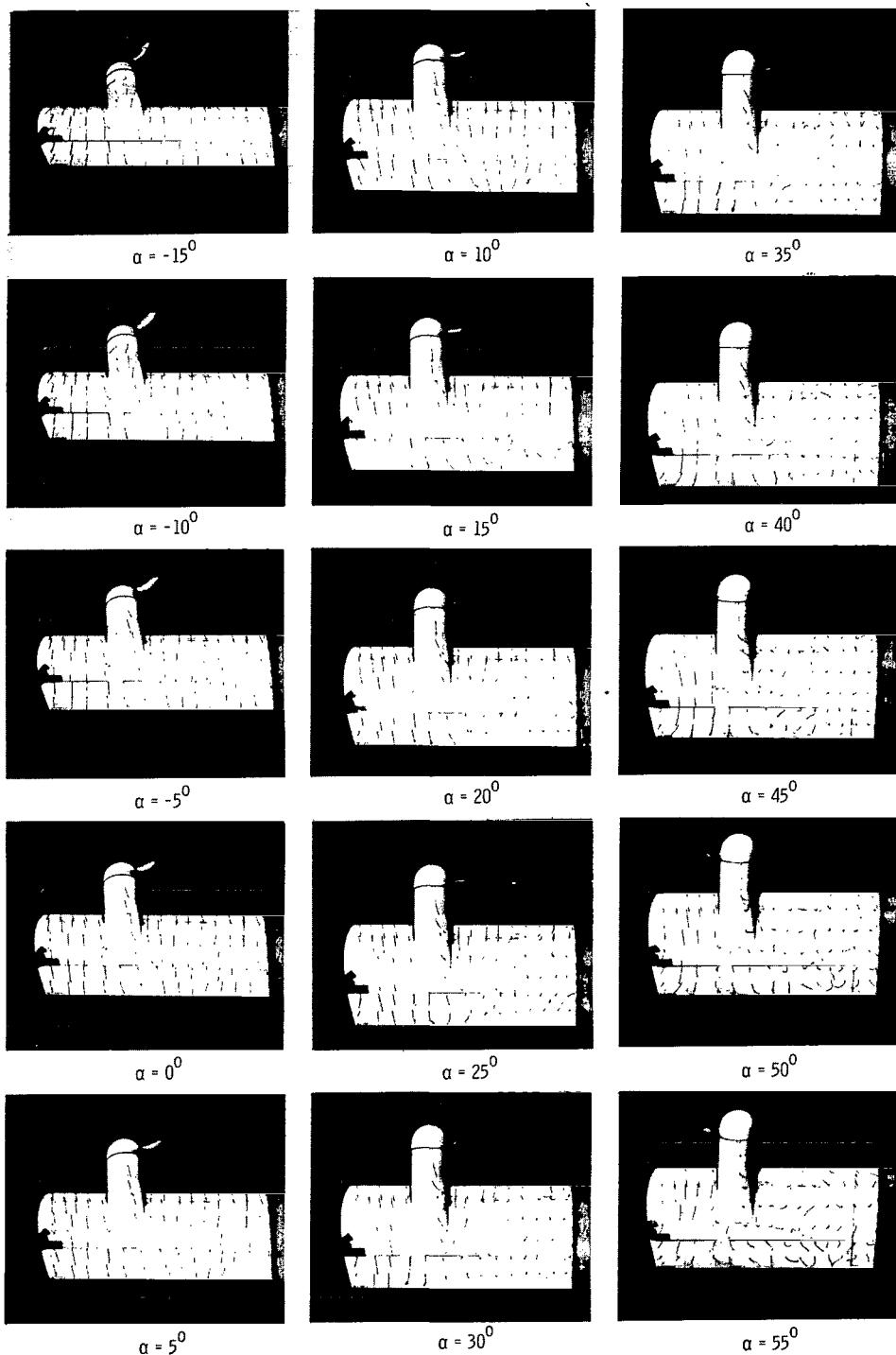
Figure 4.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4404

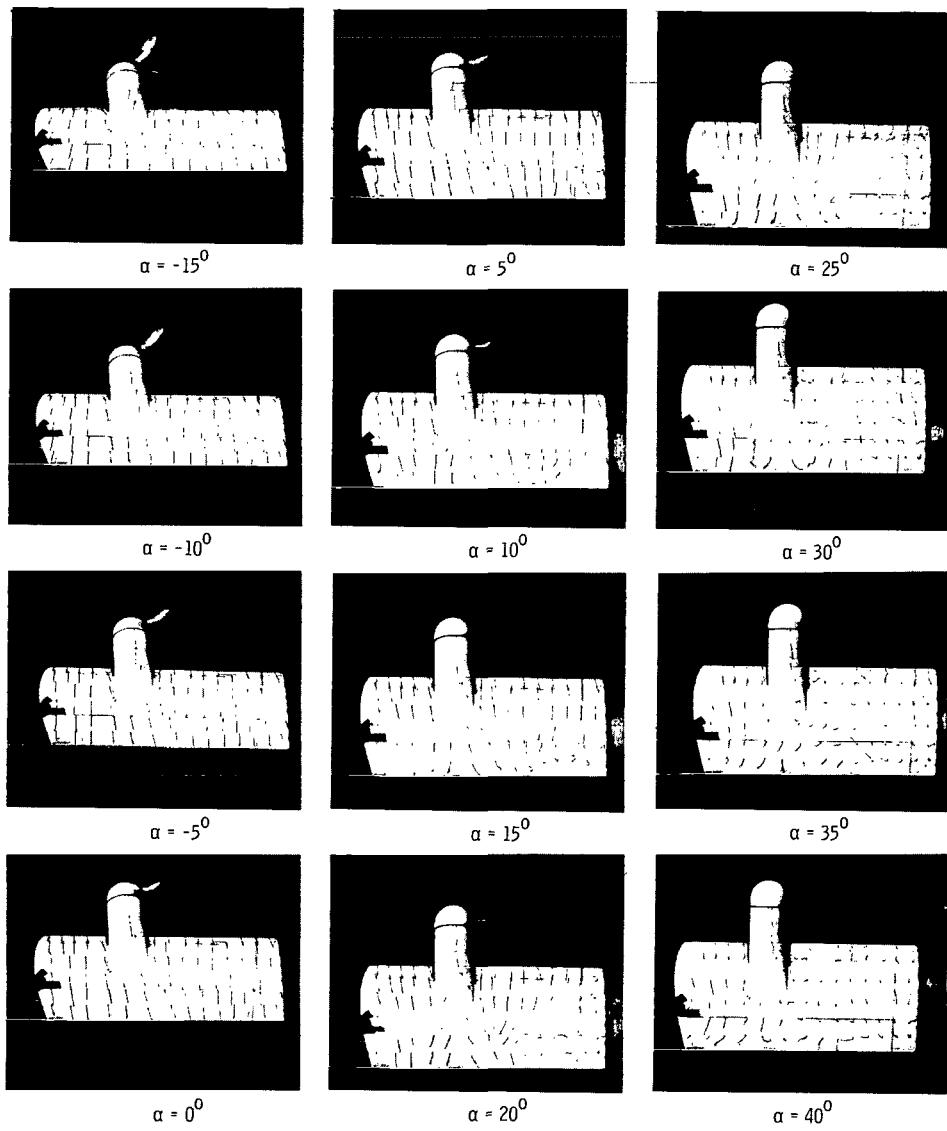
Figure 4.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60.$

L-64-4405

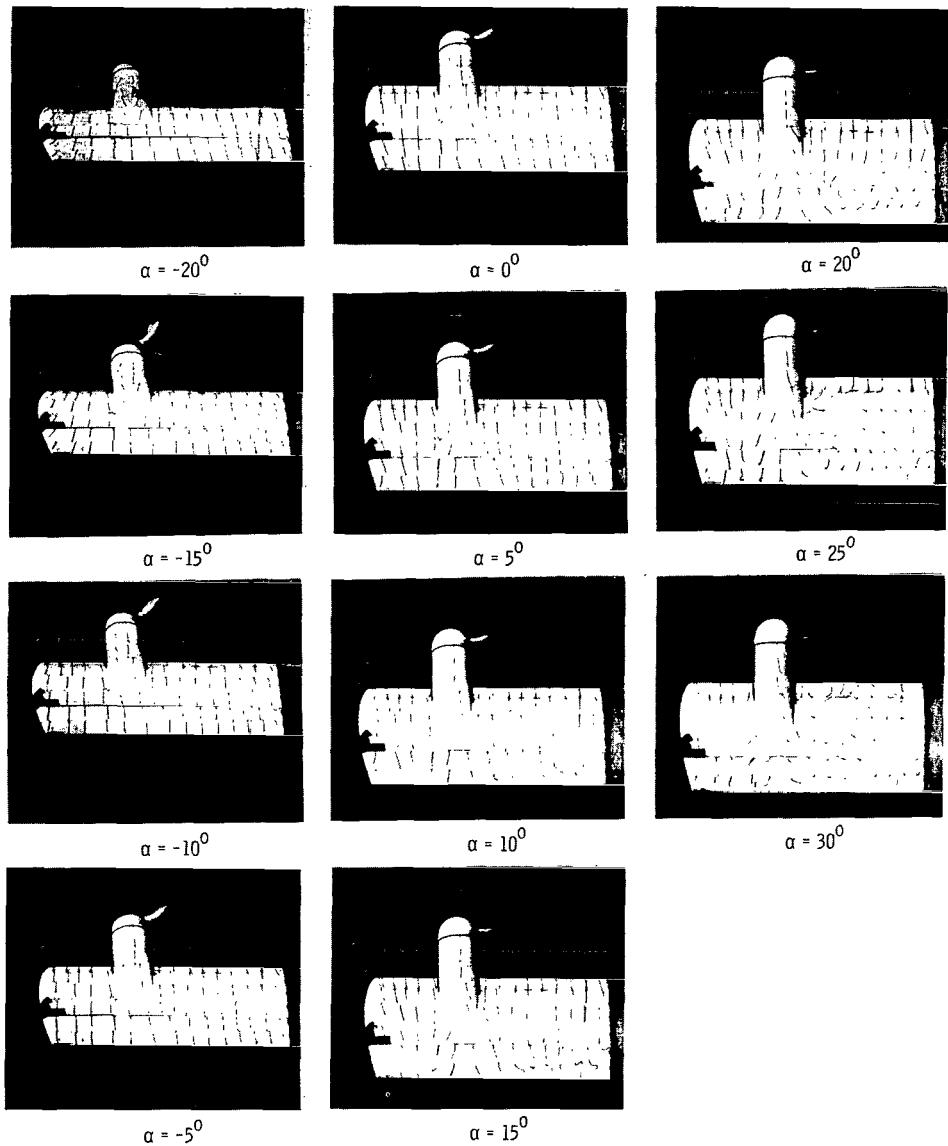
Figure 4.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30.$

L-64-4406

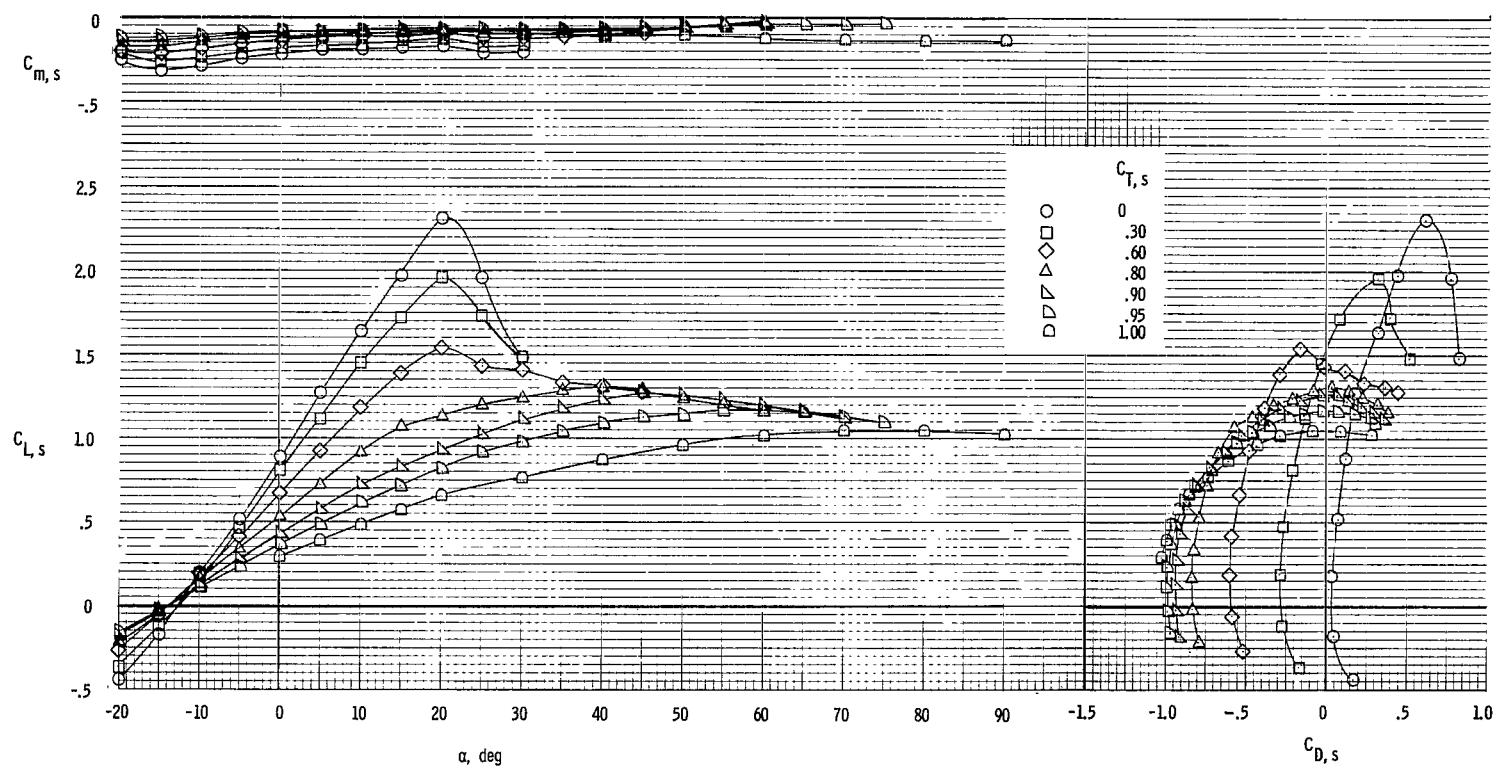
Figure 4.- Continued.



(h) Flow characteristics; $C_{T,s} = 0.$

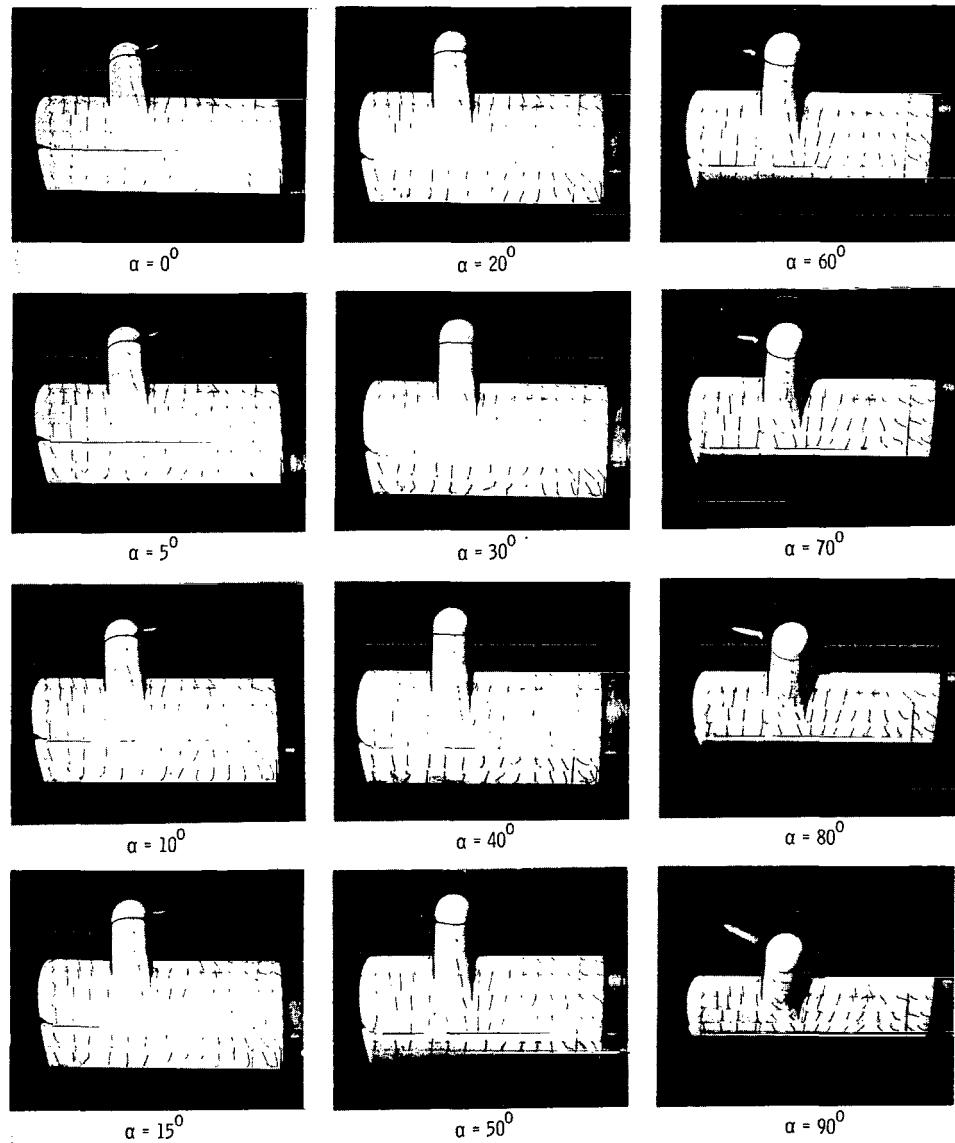
L-64-4407

Figure 4.- Concluded.



(a) Aerodynamic characteristics.

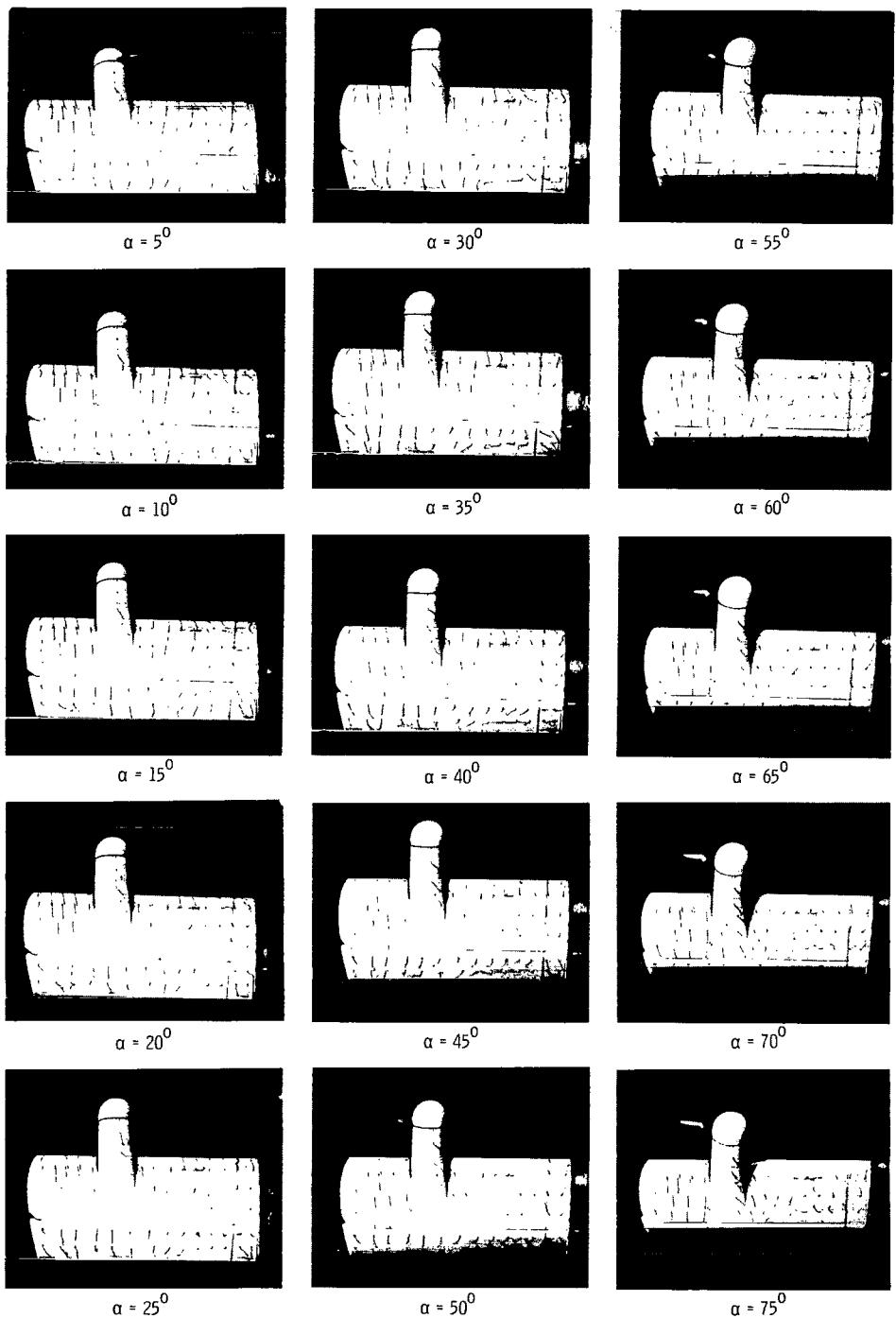
Figure 5.- Aerodynamic and flow characteristics of the model with basic leading edge and with trailing-edge flap deflected.
 $\delta_f = 20^\circ$.



(b) Flow characteristics; $C_{T,S} = 1.00$.

L-64-4408

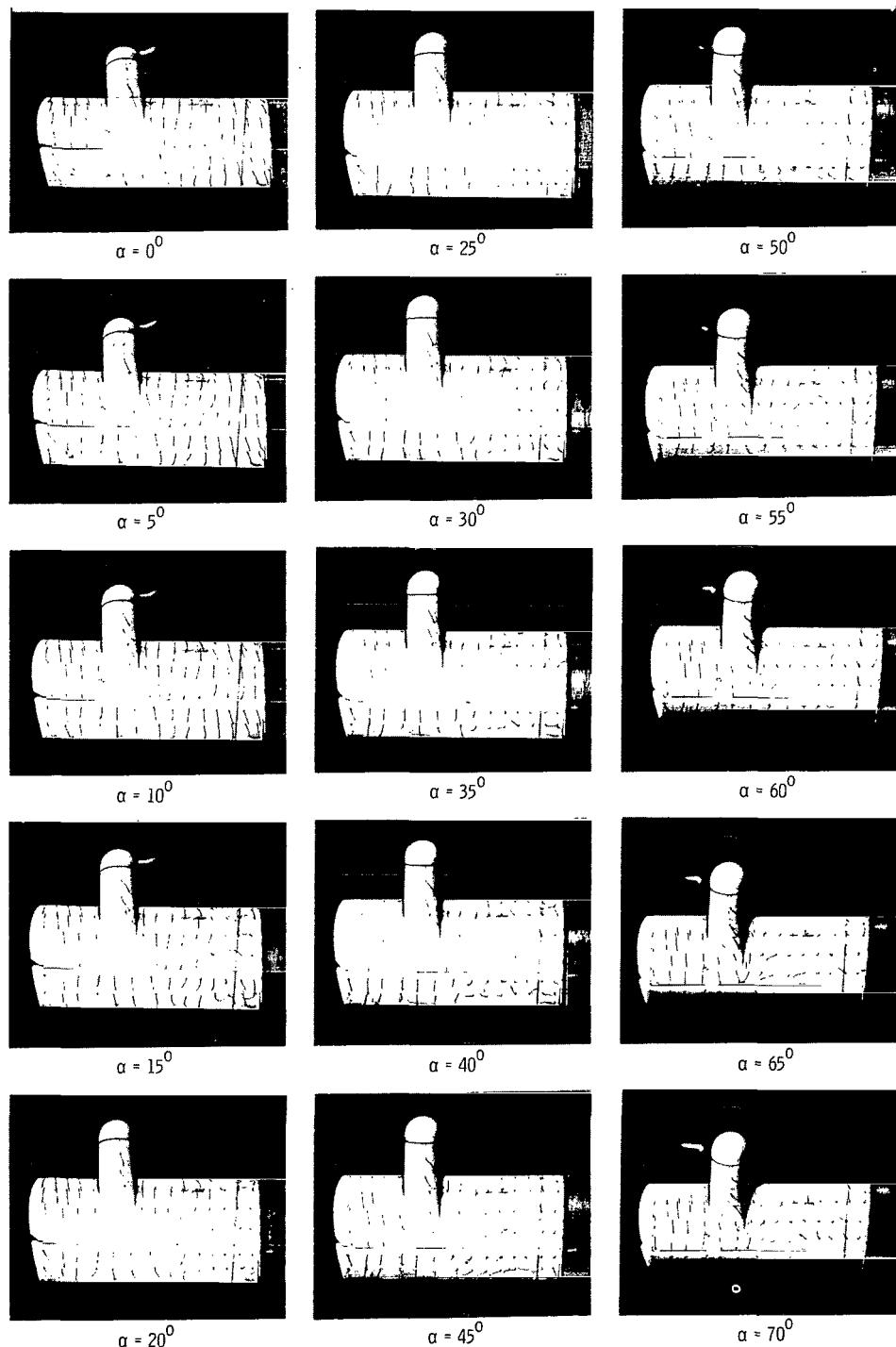
Figure 5.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4409

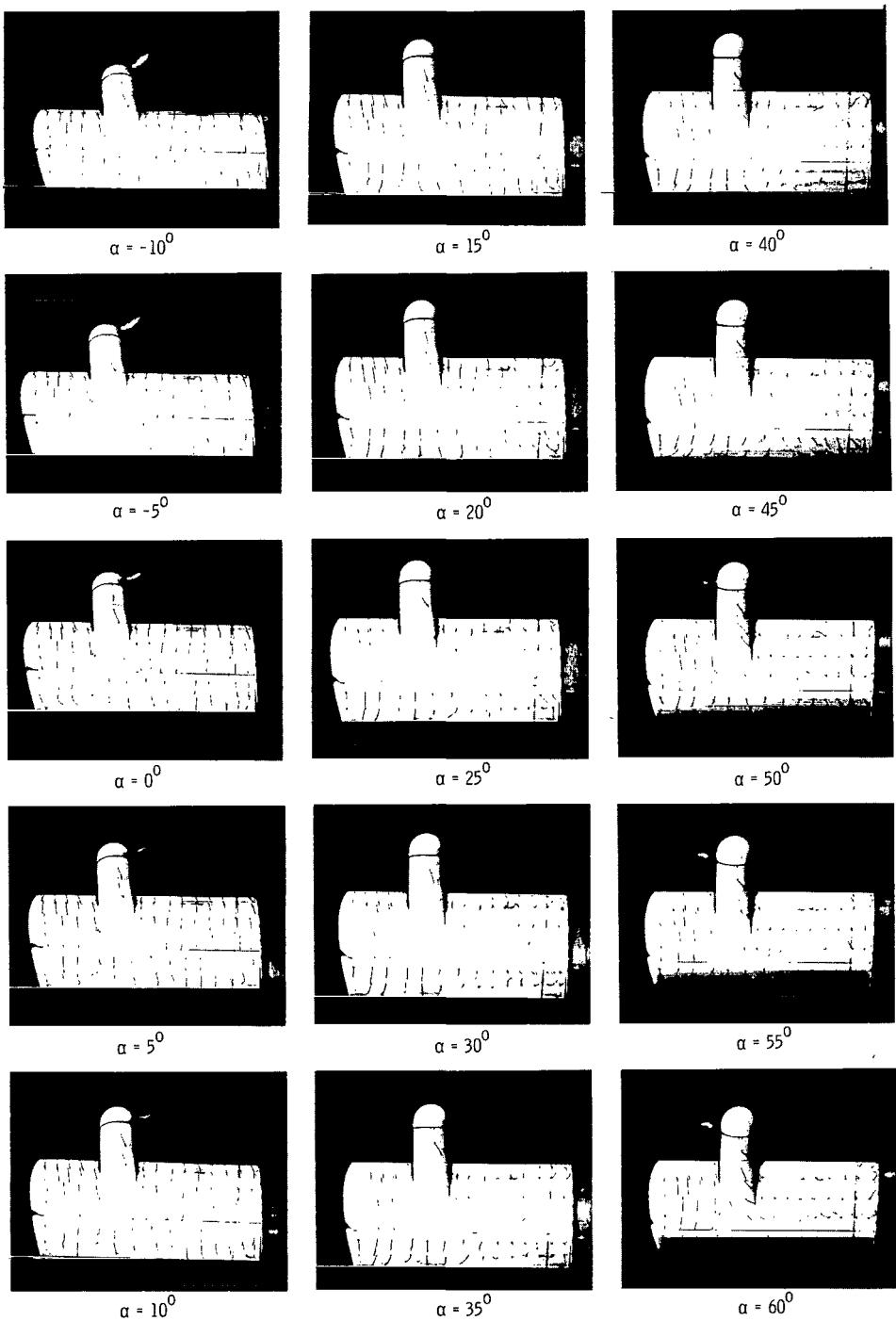
Figure 5.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90.$

L-64-4410

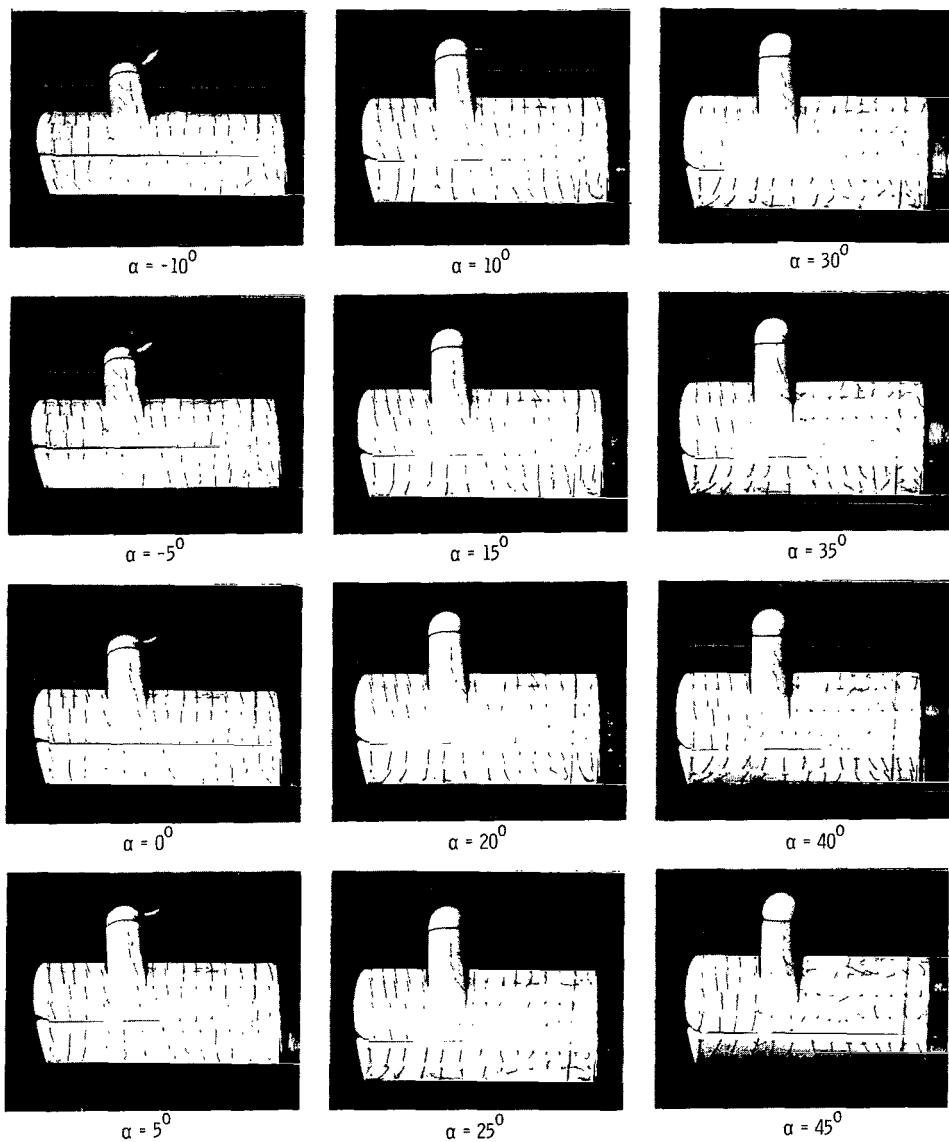
Figure 5.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4411

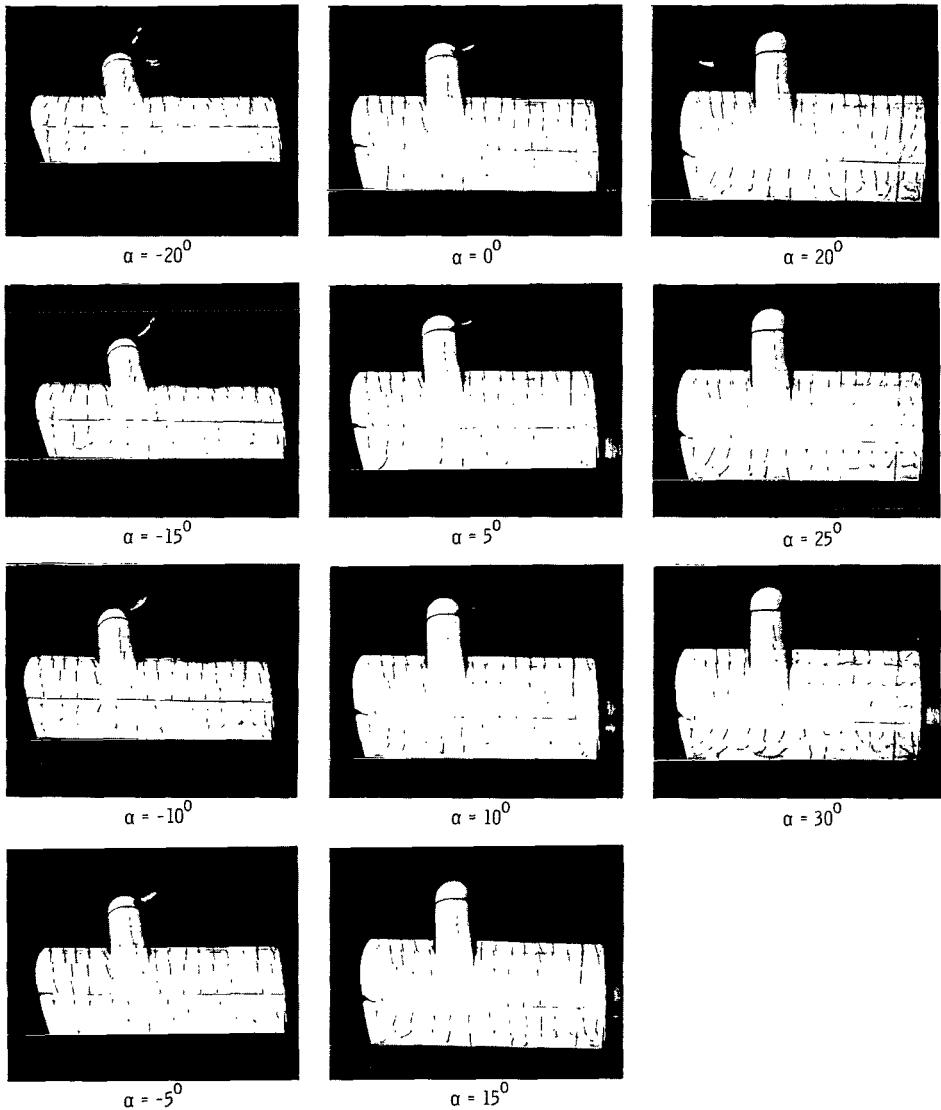
Figure 5.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60.$

L-64-4412

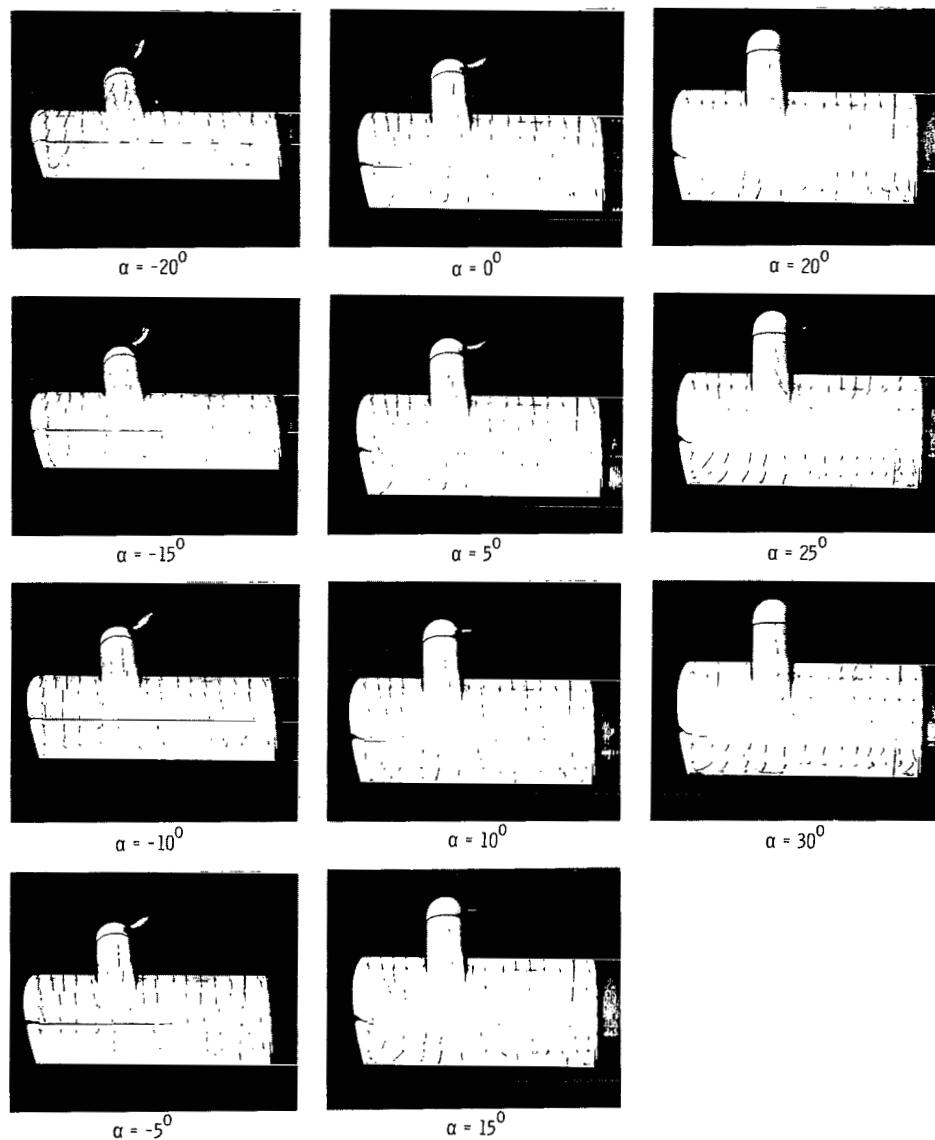
Figure 5.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30.$

L-64-4413

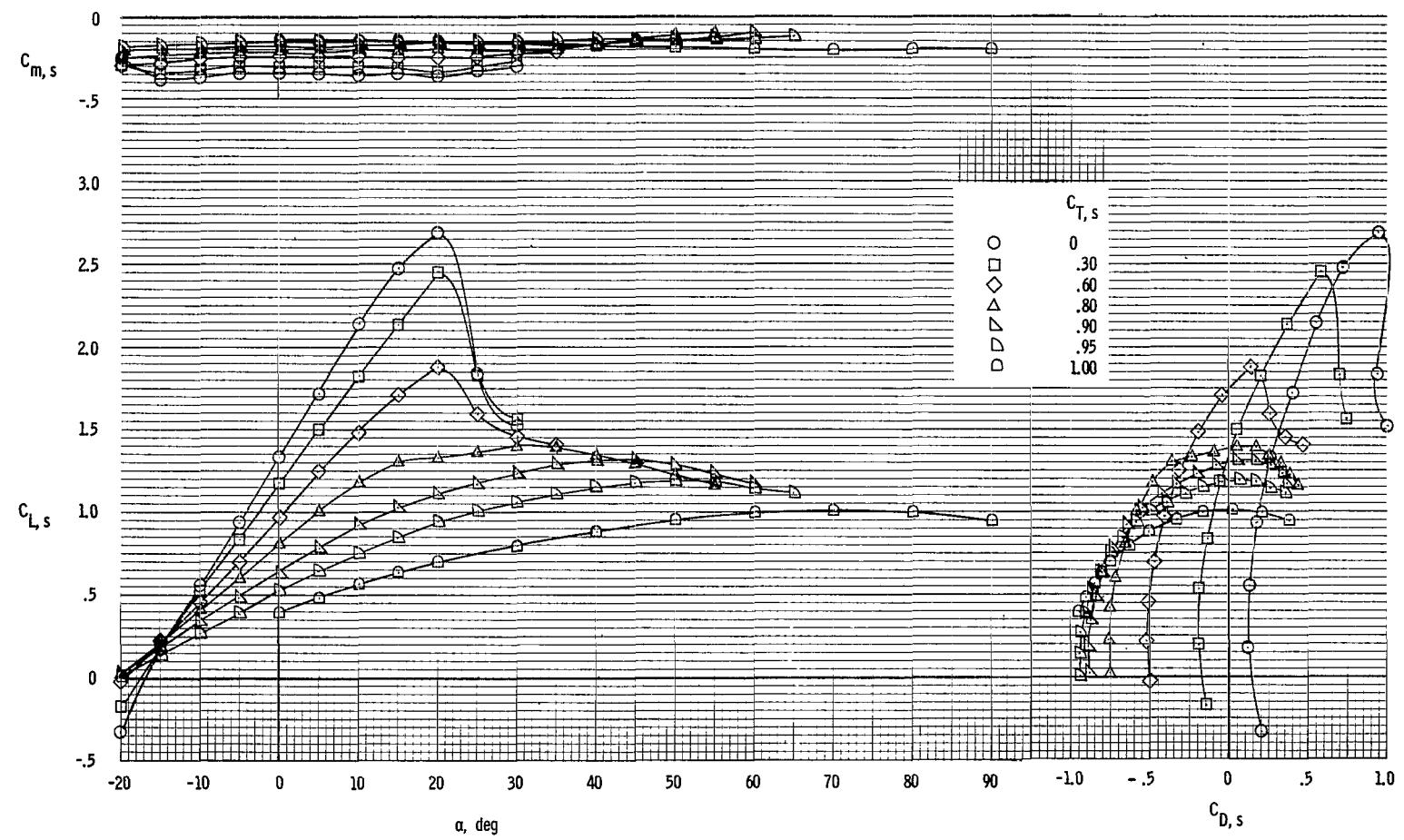
Figure 5.- Continued.



(h) Flow characteristics; $C_{T,s} = 0$.

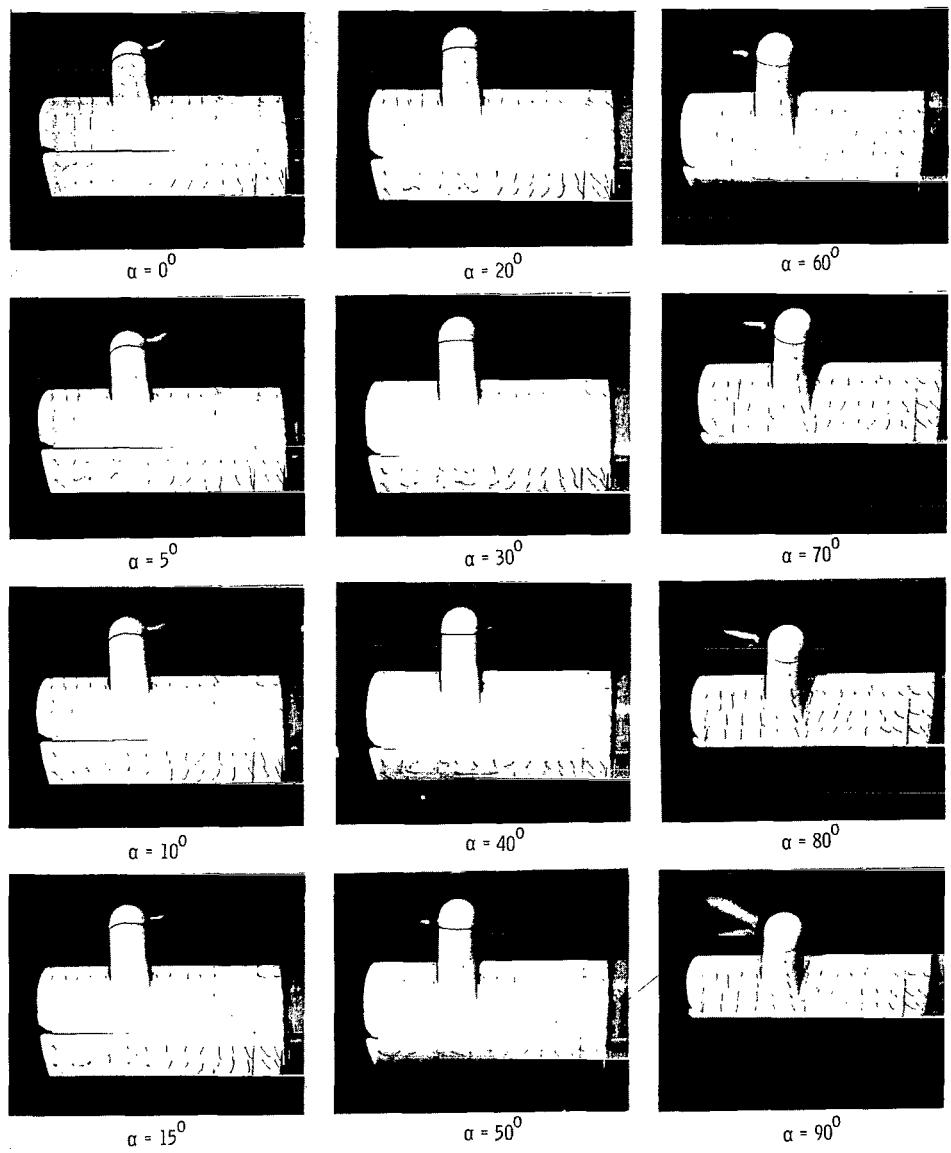
L-64-4414

Figure 5.- Concluded.



(a) Aerodynamic characteristics.

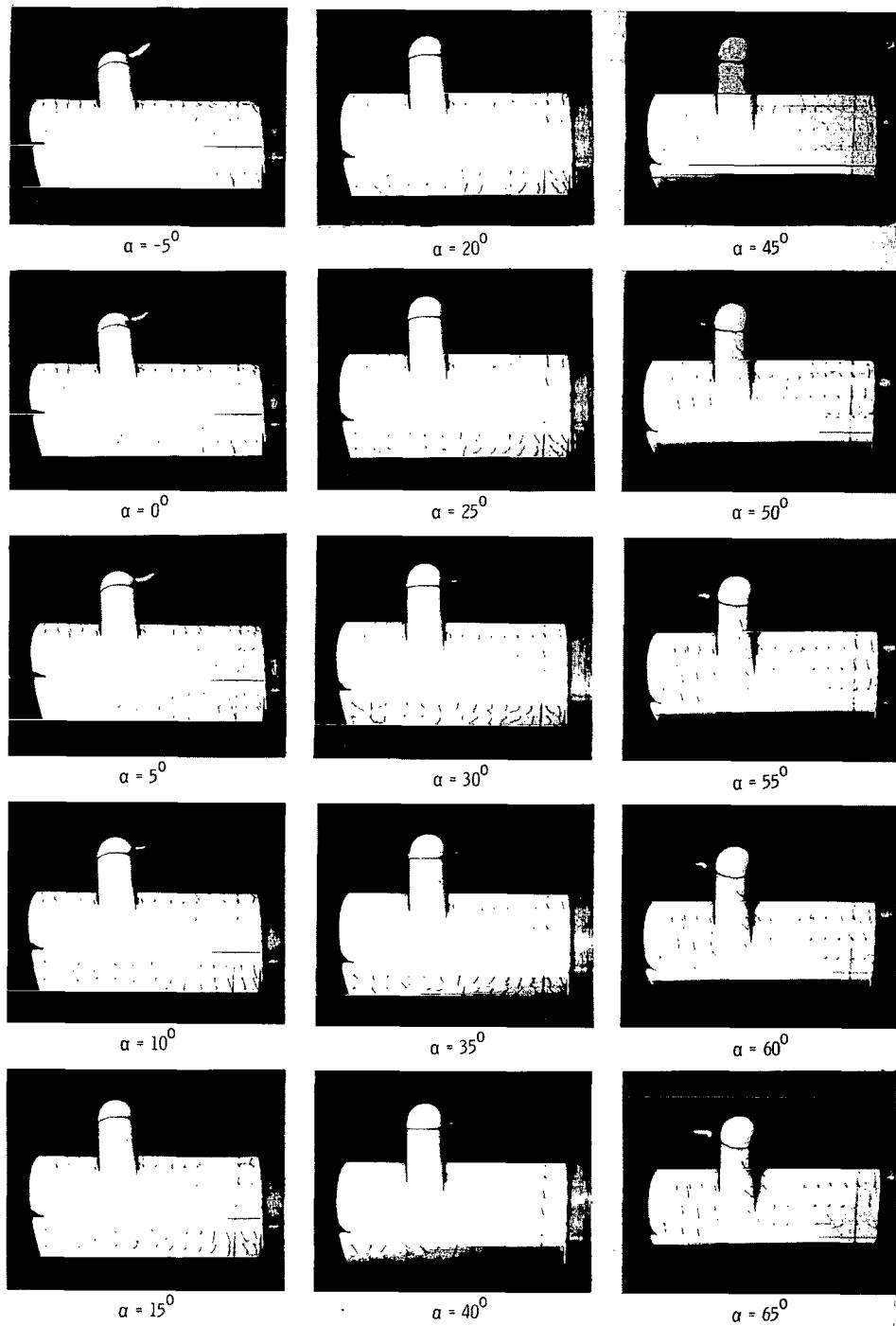
Figure 6.- Aerodynamic and flow characteristics of the model with basic leading edge and with trailing-edge flap deflected.
 $\delta_f = 40^\circ$.



(b) Flow characteristics; $C_{T,s} = 1.00.$

L-64-4415

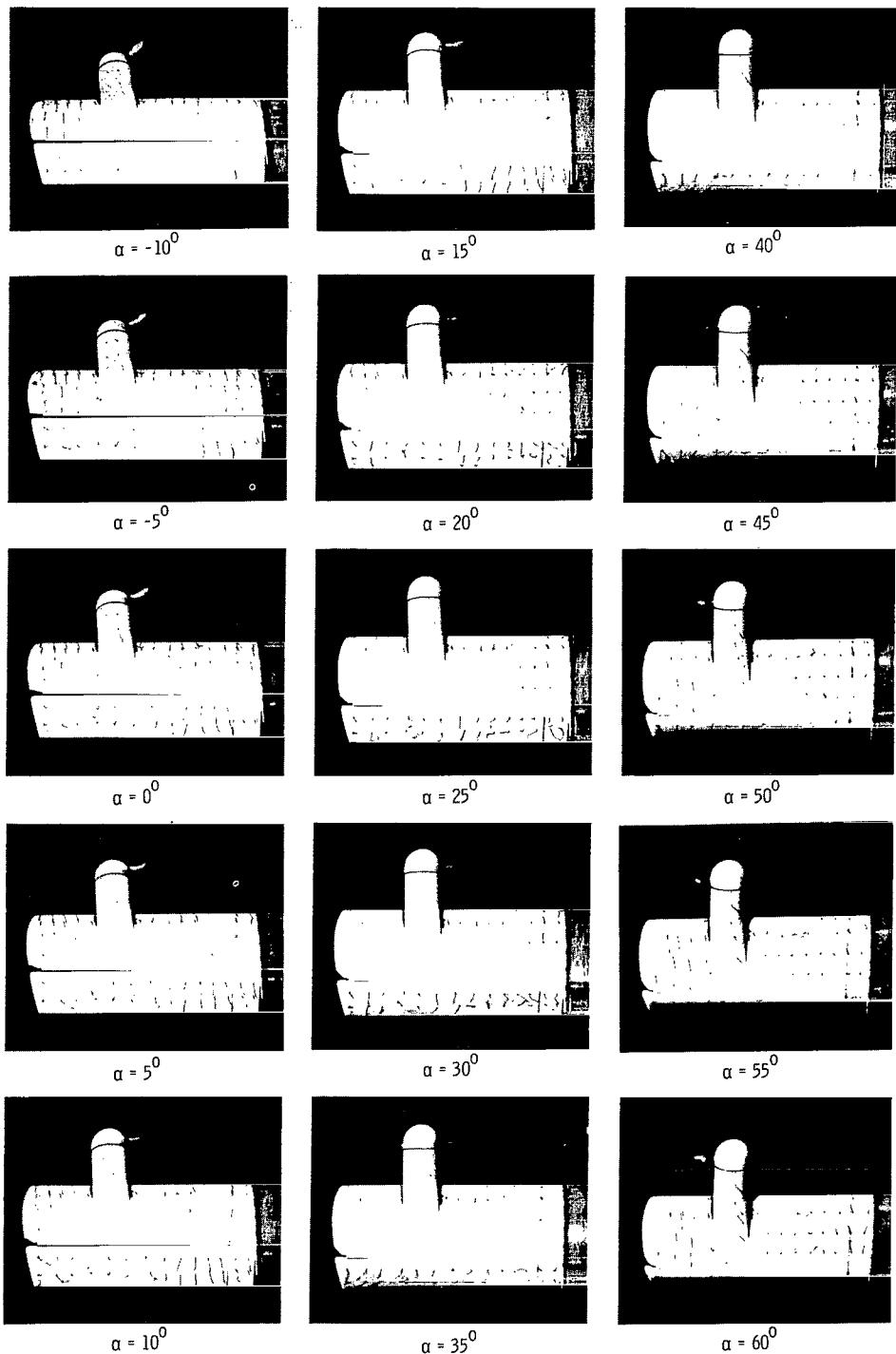
Figure 6.. Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4416

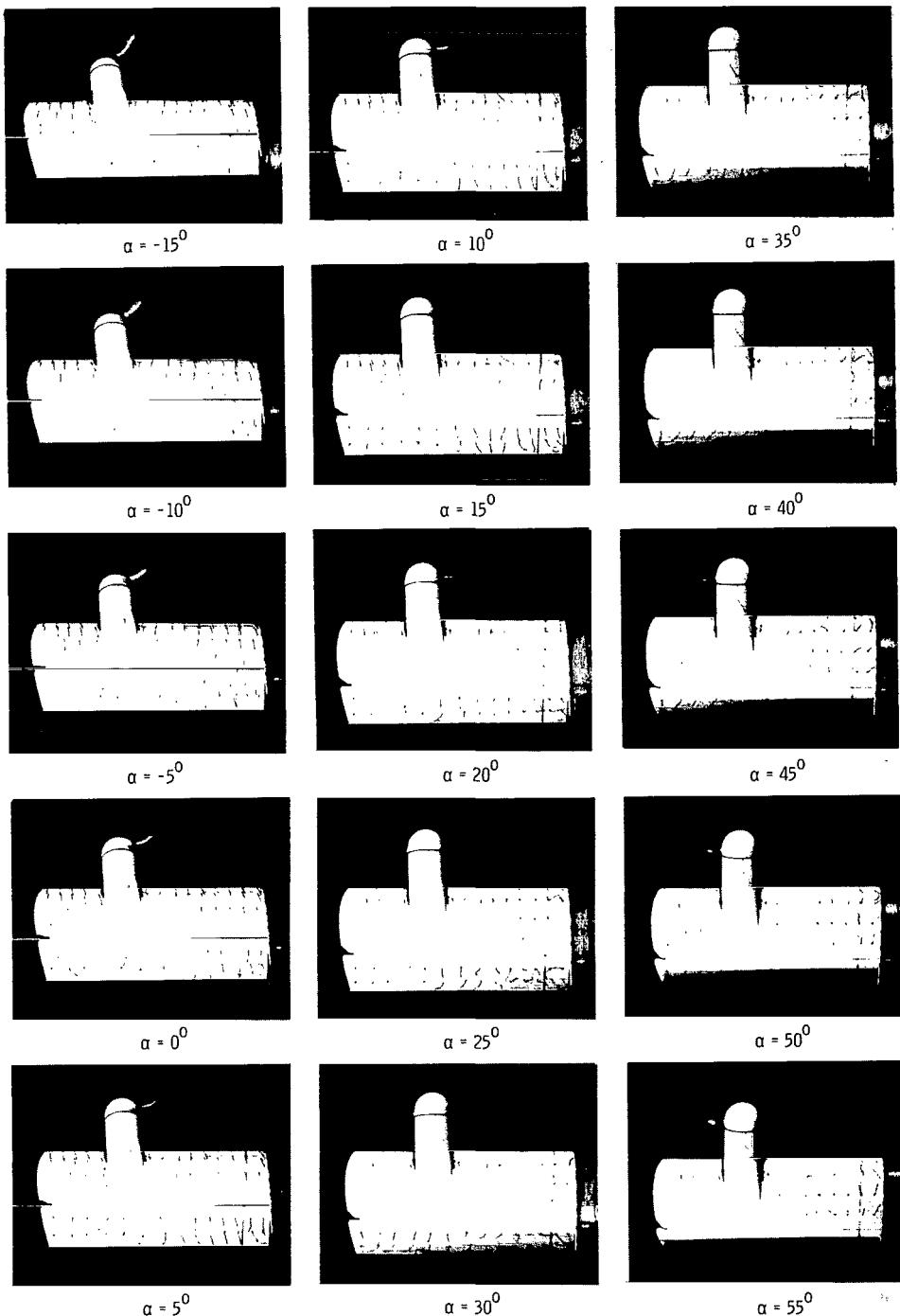
Figure 6.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4417

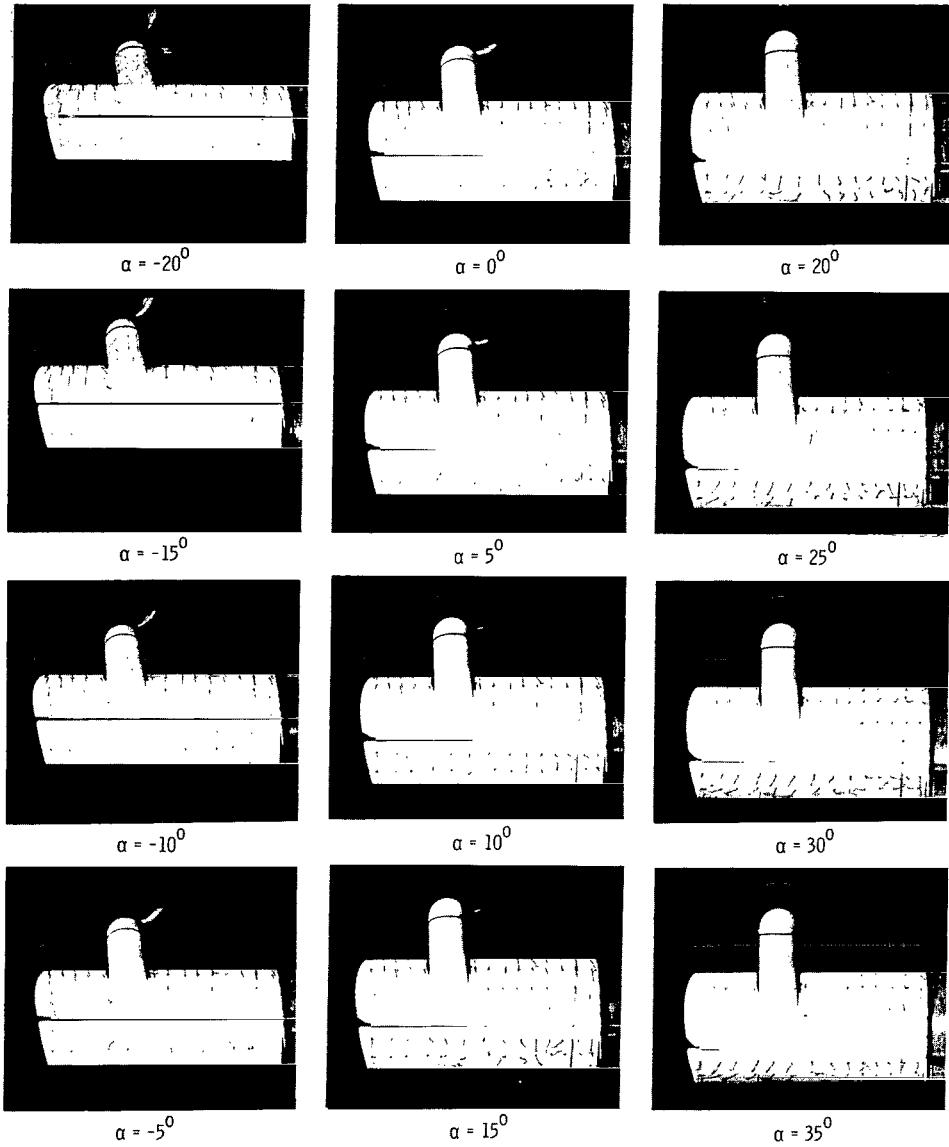
Figure 6.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4418

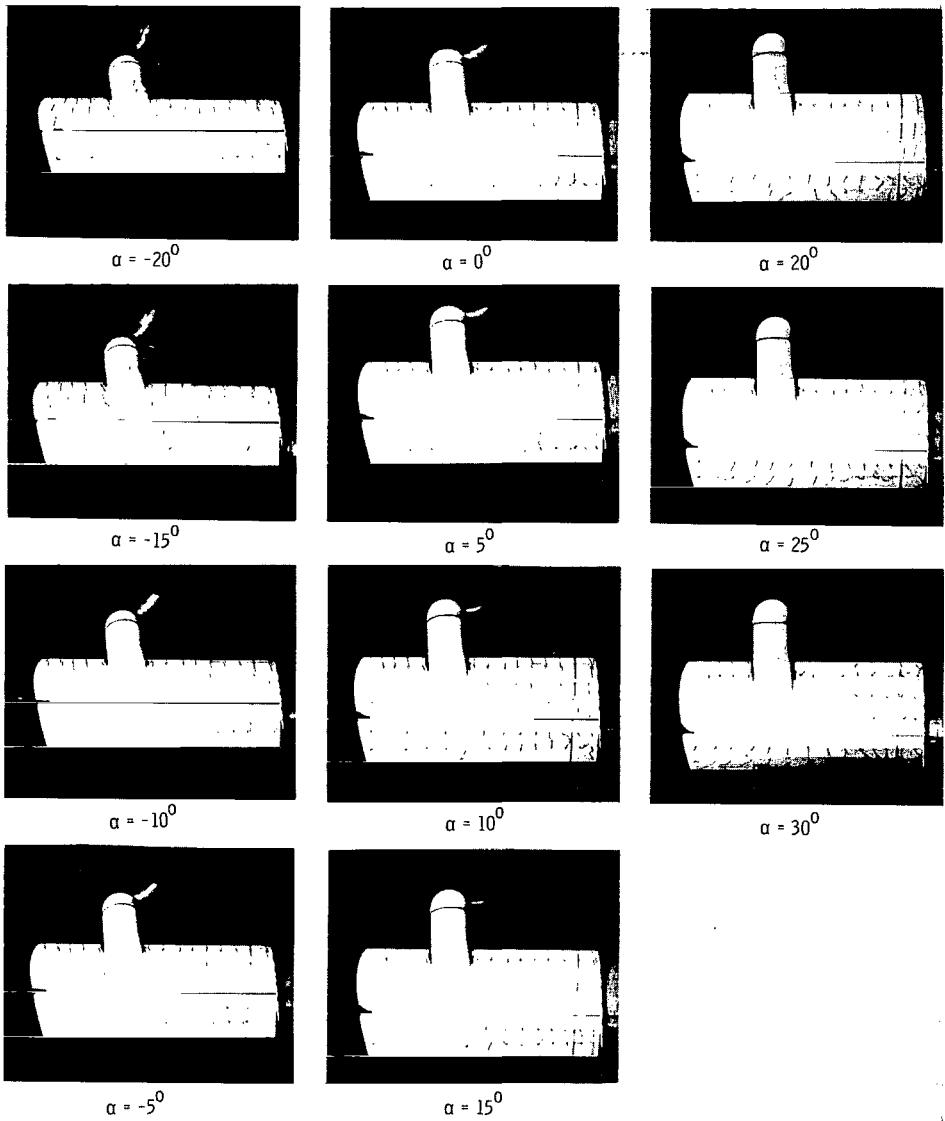
Figure 6.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60.$

L-64-4419

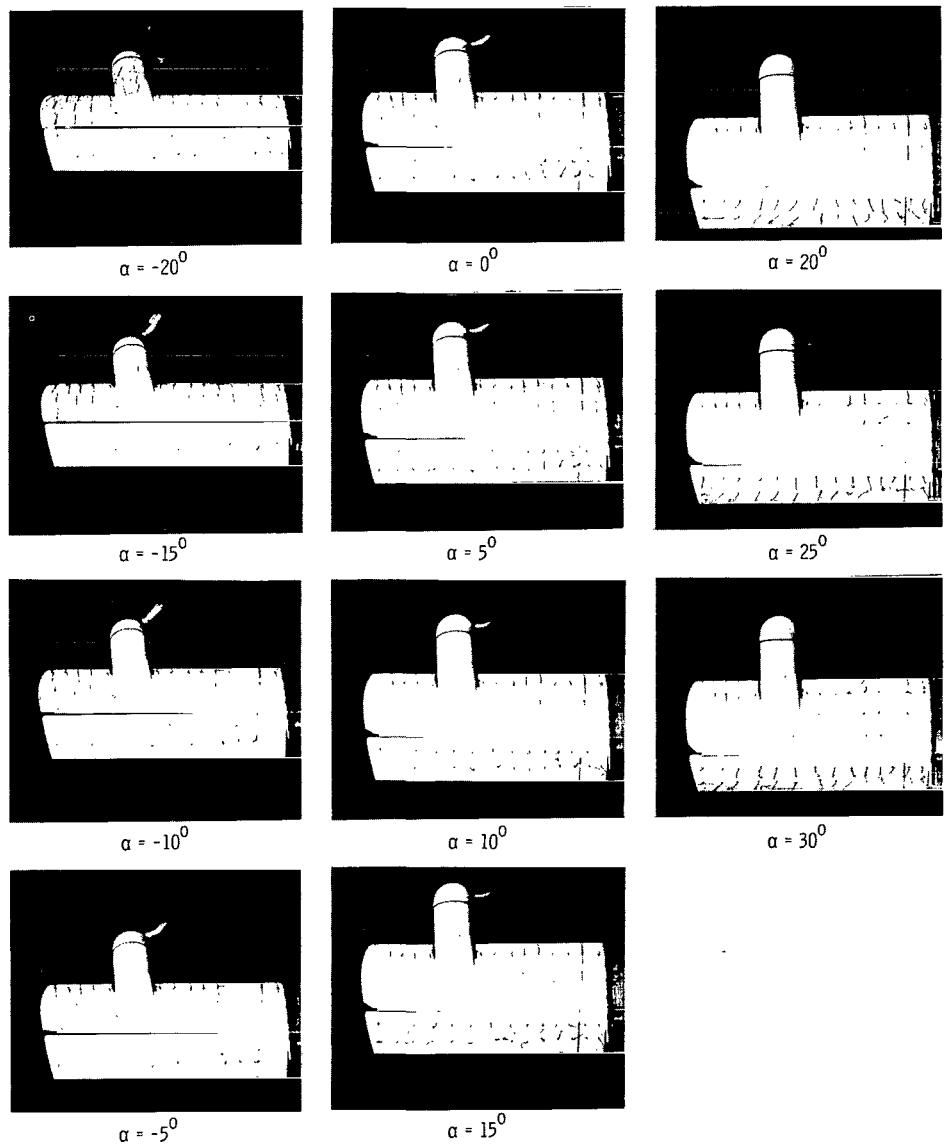
Figure 6.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30.$

L-64-4420

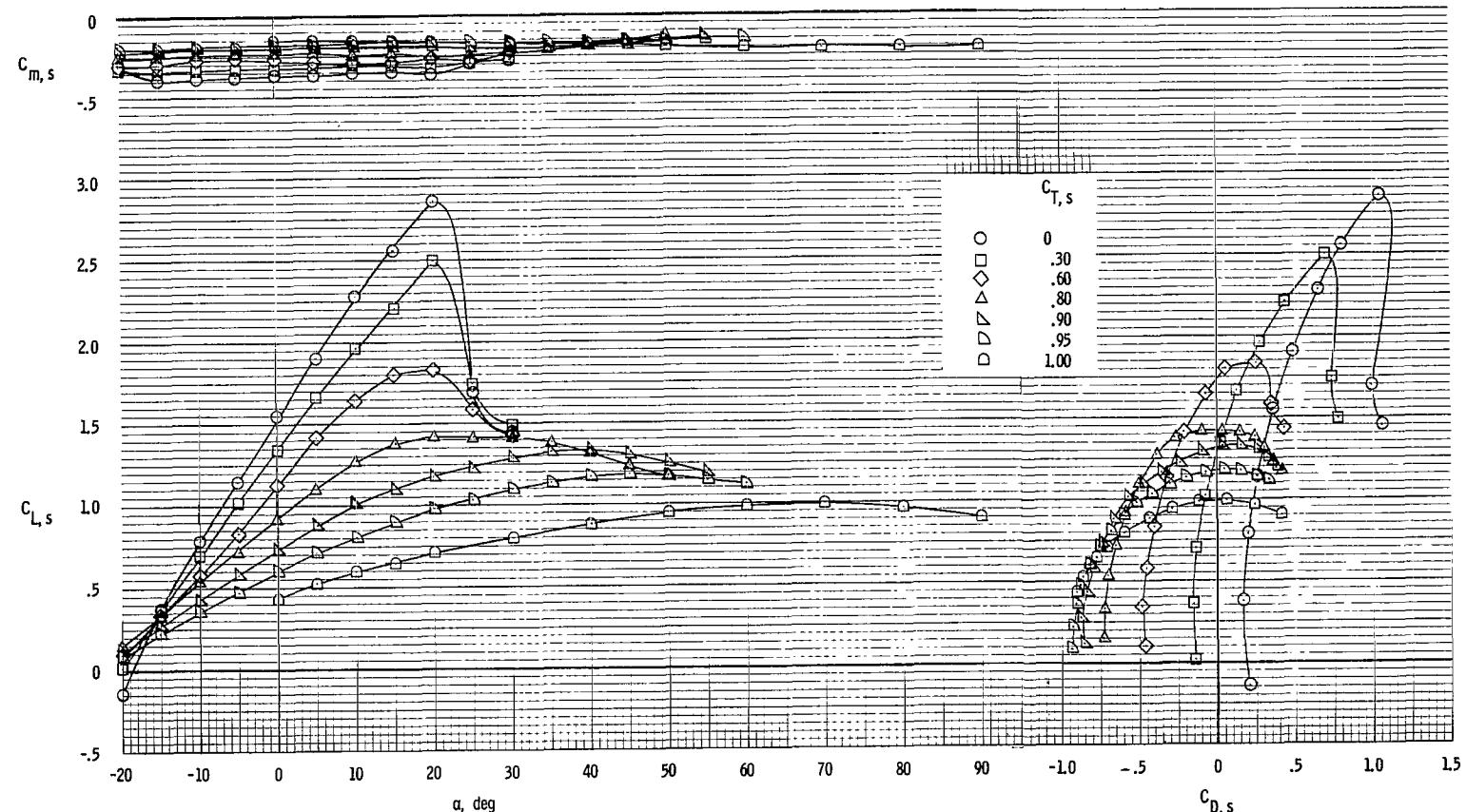
Figure 6.- Continued.



(h) Flow characteristics; $C_{T,s} = 0$.

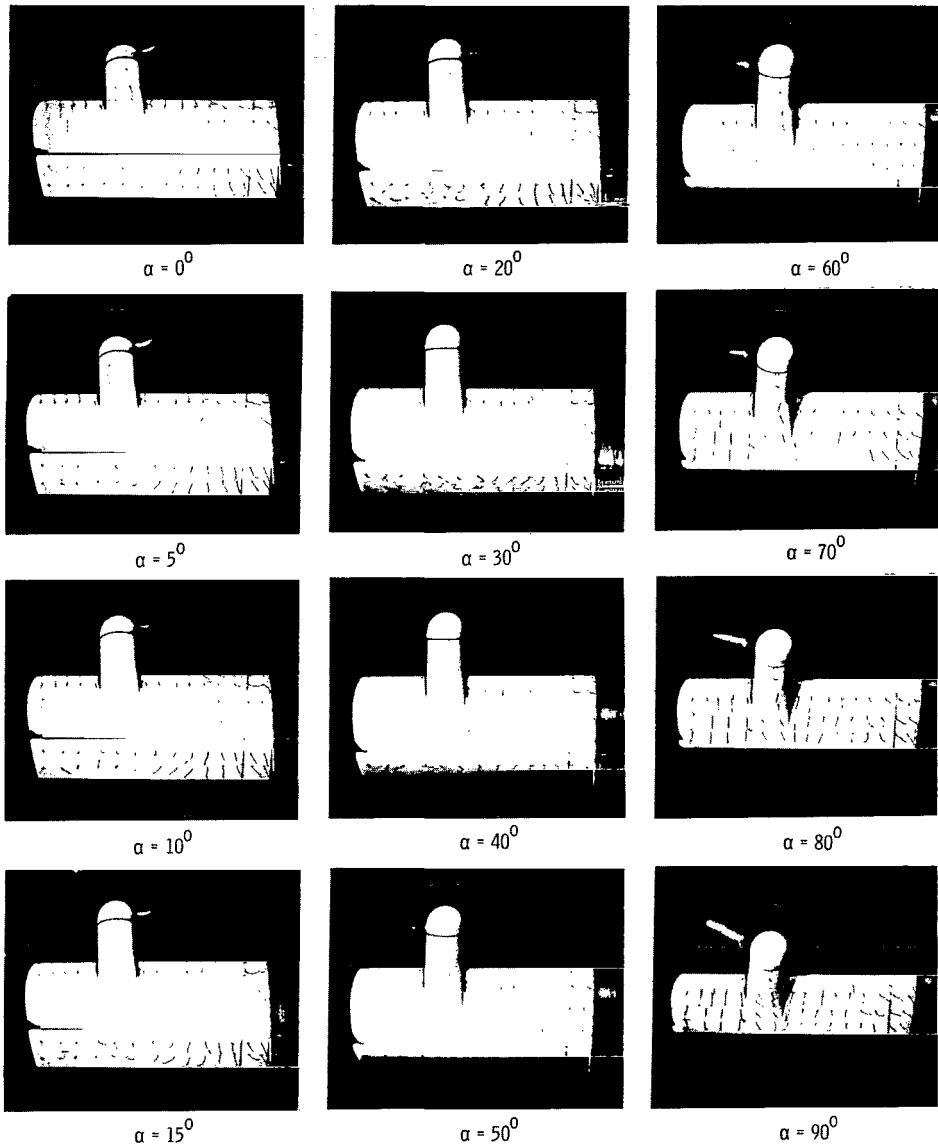
L-64-4421

Figure 6..- Concluded.



(a) Aerodynamic characteristics.

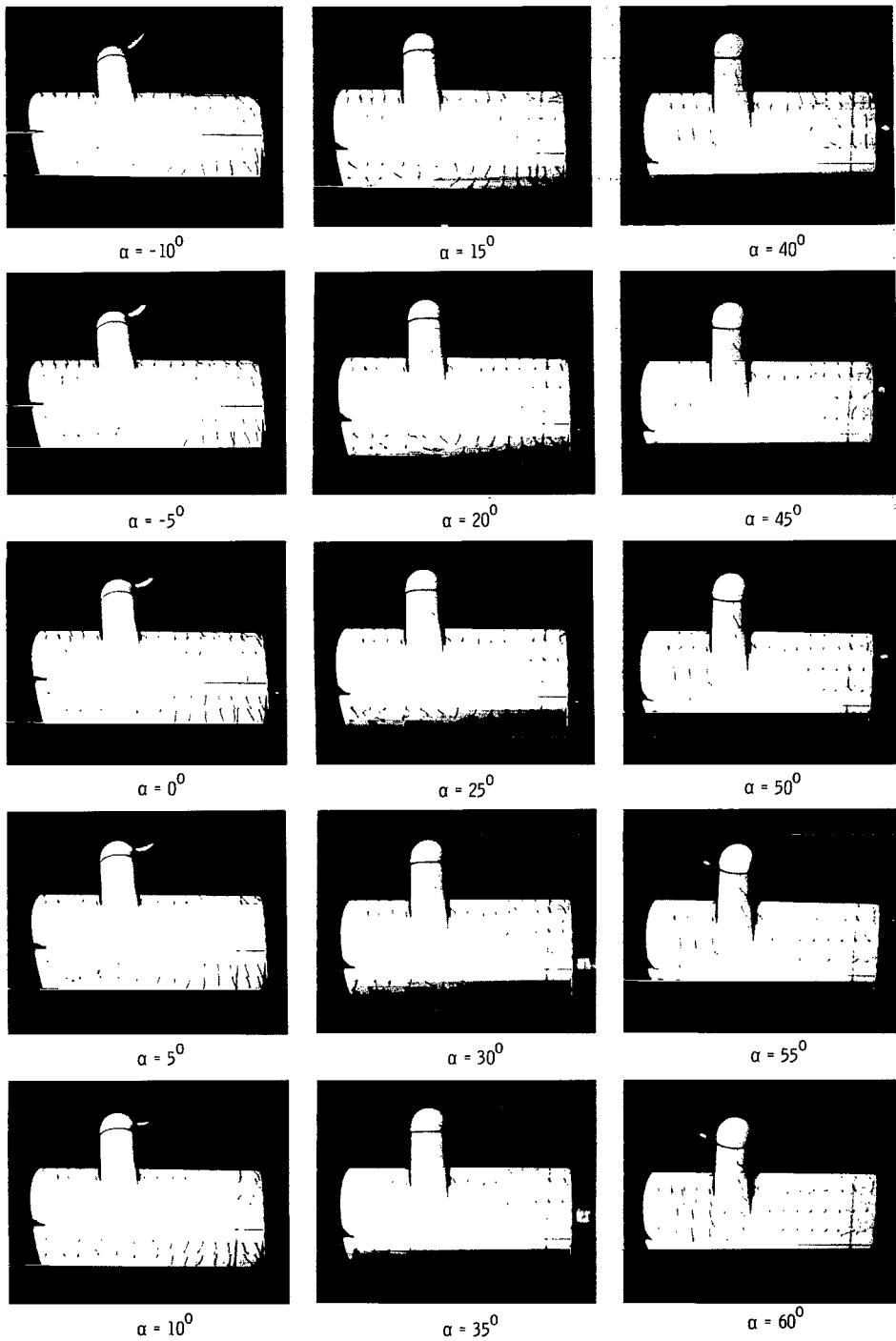
Figure 7.- Aerodynamic and flow characteristics of the model with basic leading edge and with trailing-edge flap deflected.
 $\delta_f = 50^\circ$.



(b) Flow characteristics; $C_{T,s} = 1.00$.

L-64-4422

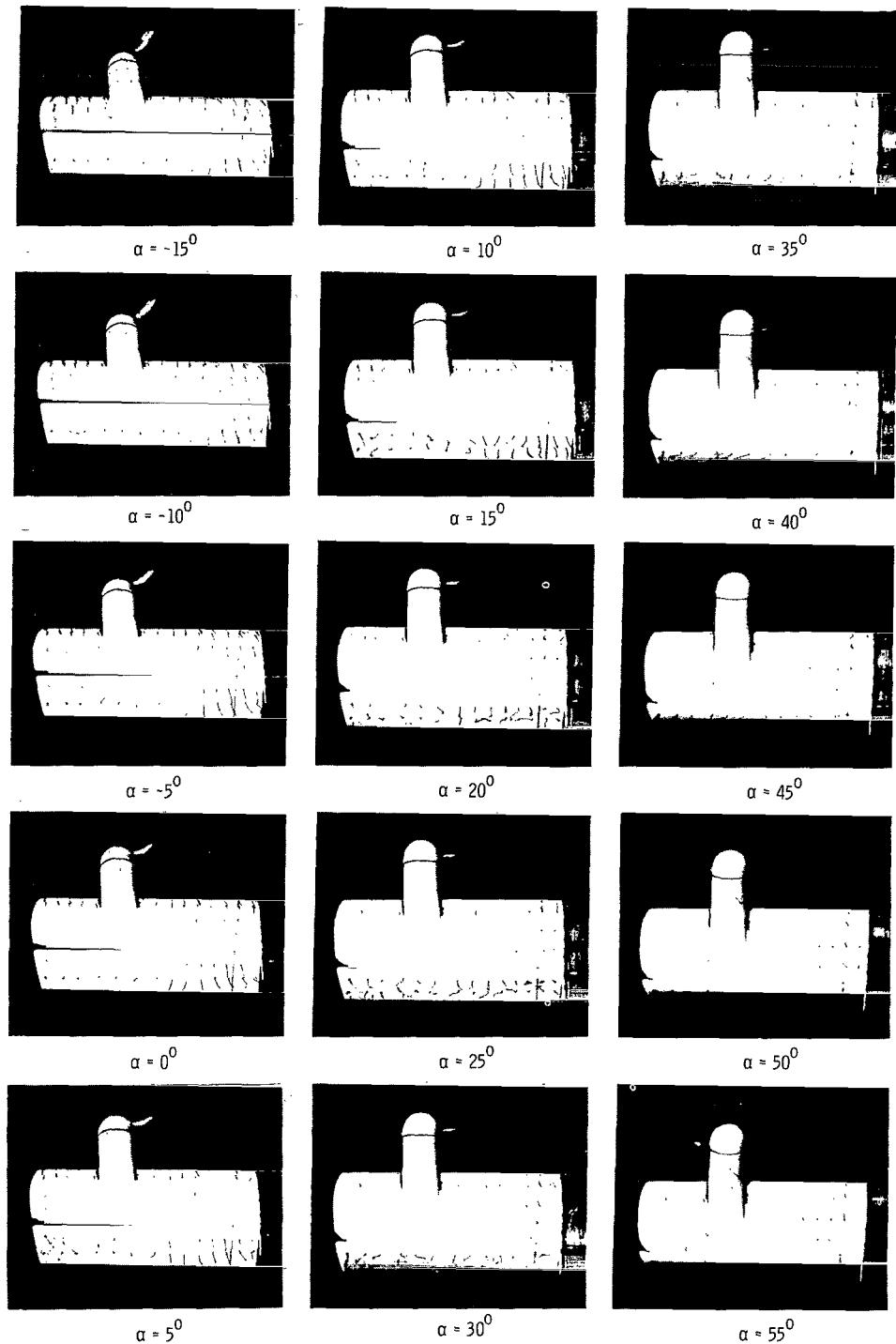
Figure 7.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4423

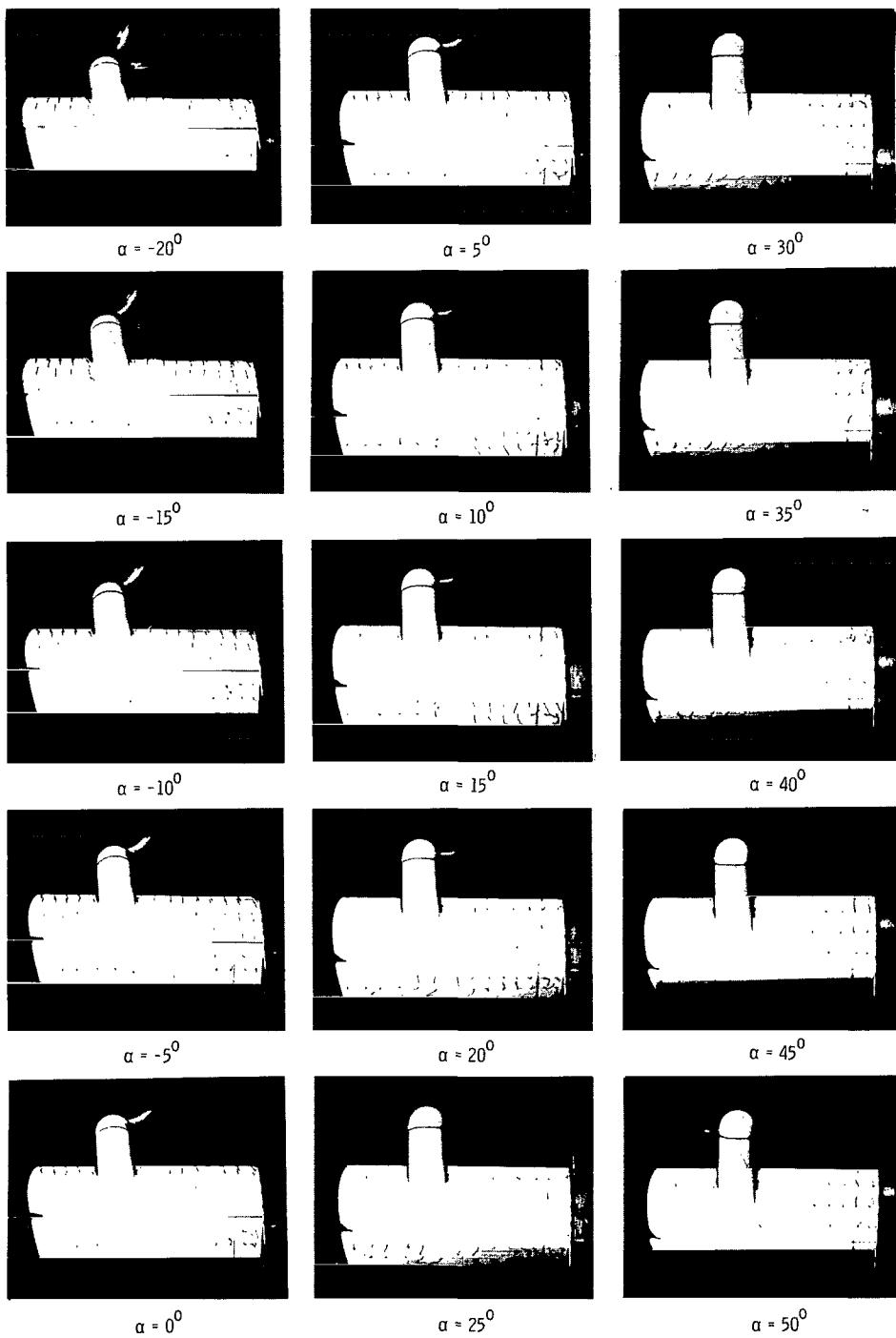
Figure 7.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4424

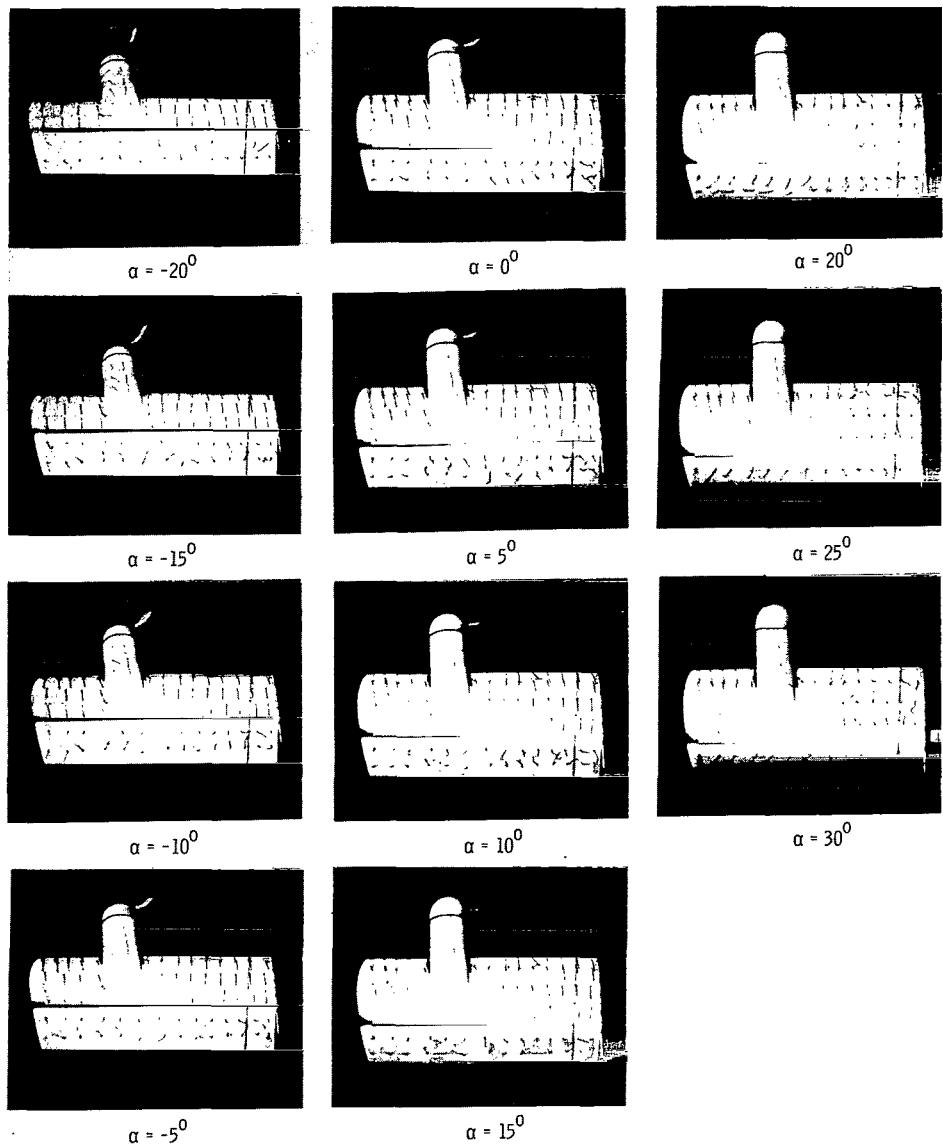
Figure 7.- Continued.



(e) Flow characteristics; $C_{T,S} = 0.80$.

L-64-4425

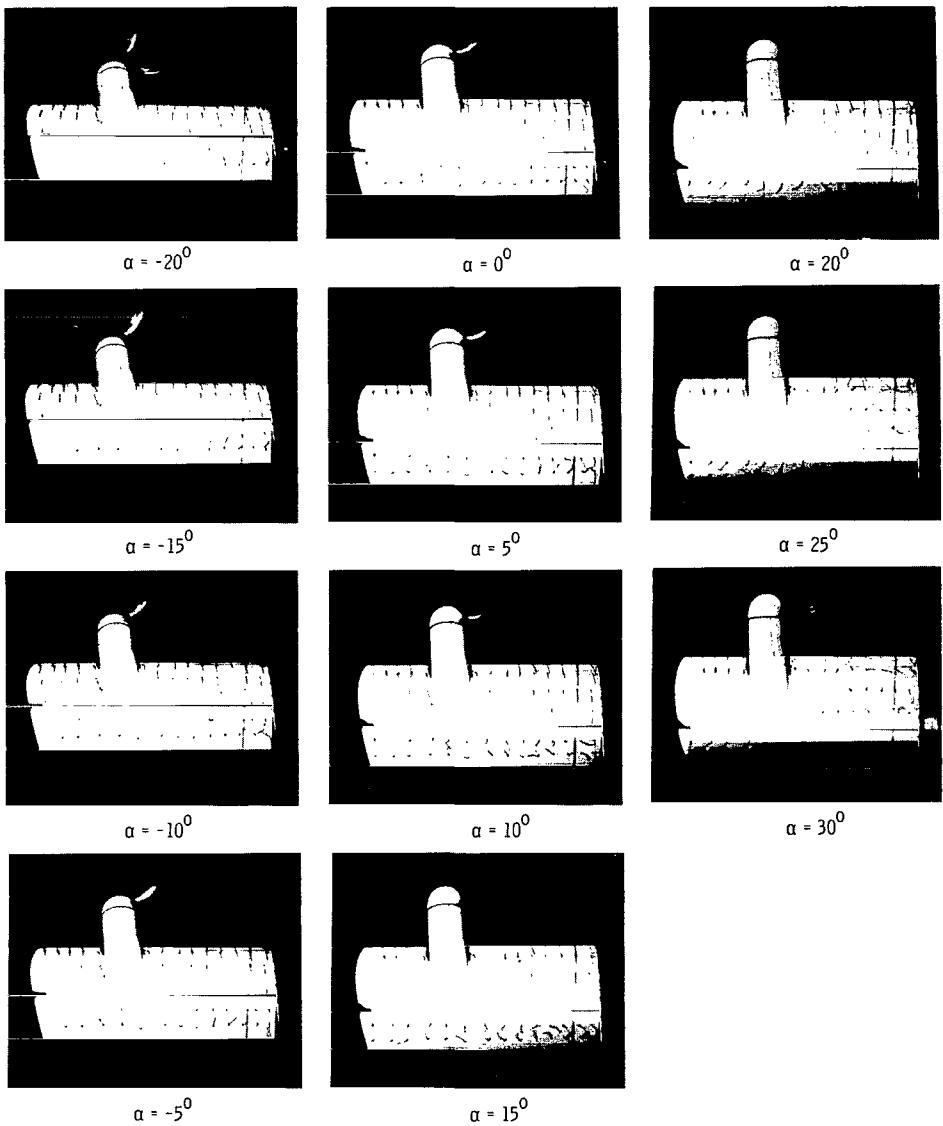
Figure 7.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60$.

L-64-4426

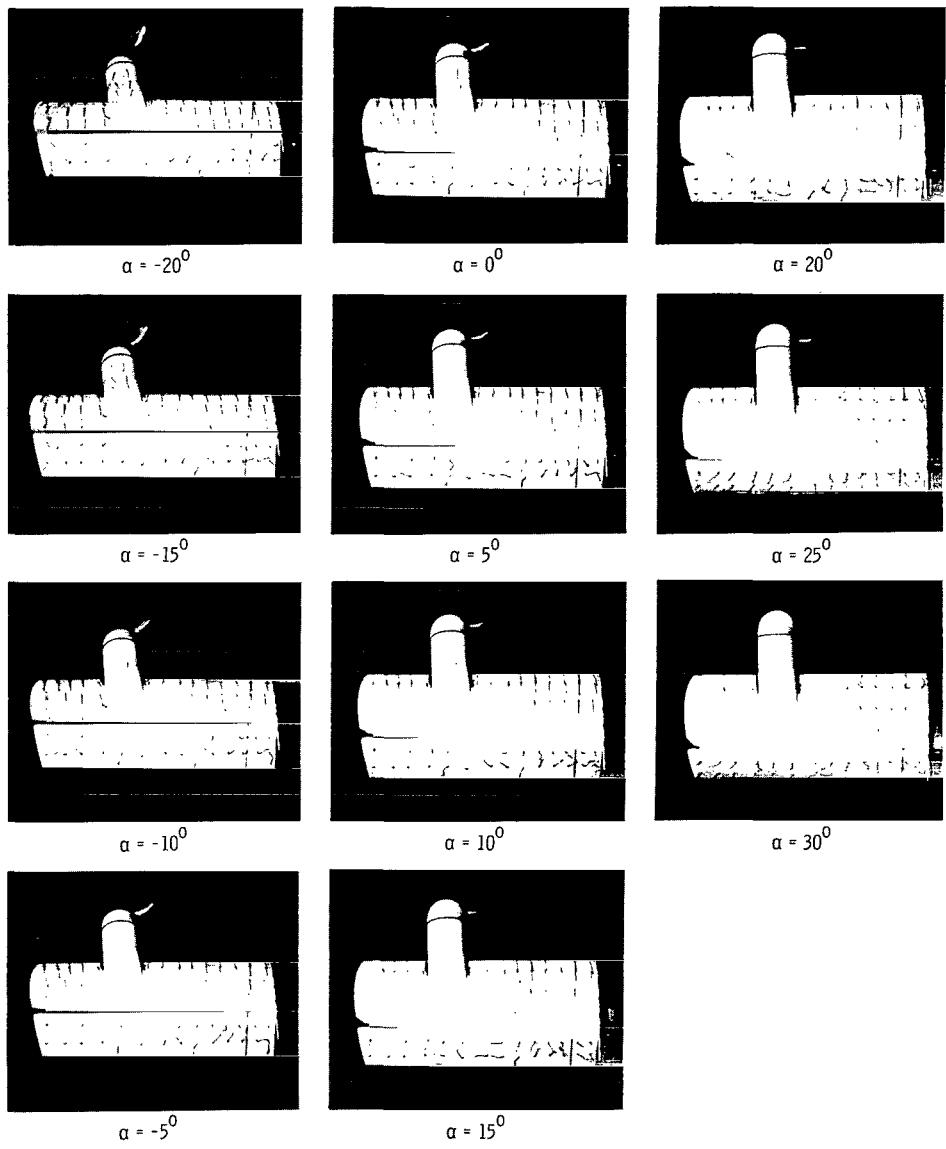
Figure 7.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30.$

L-64-4427

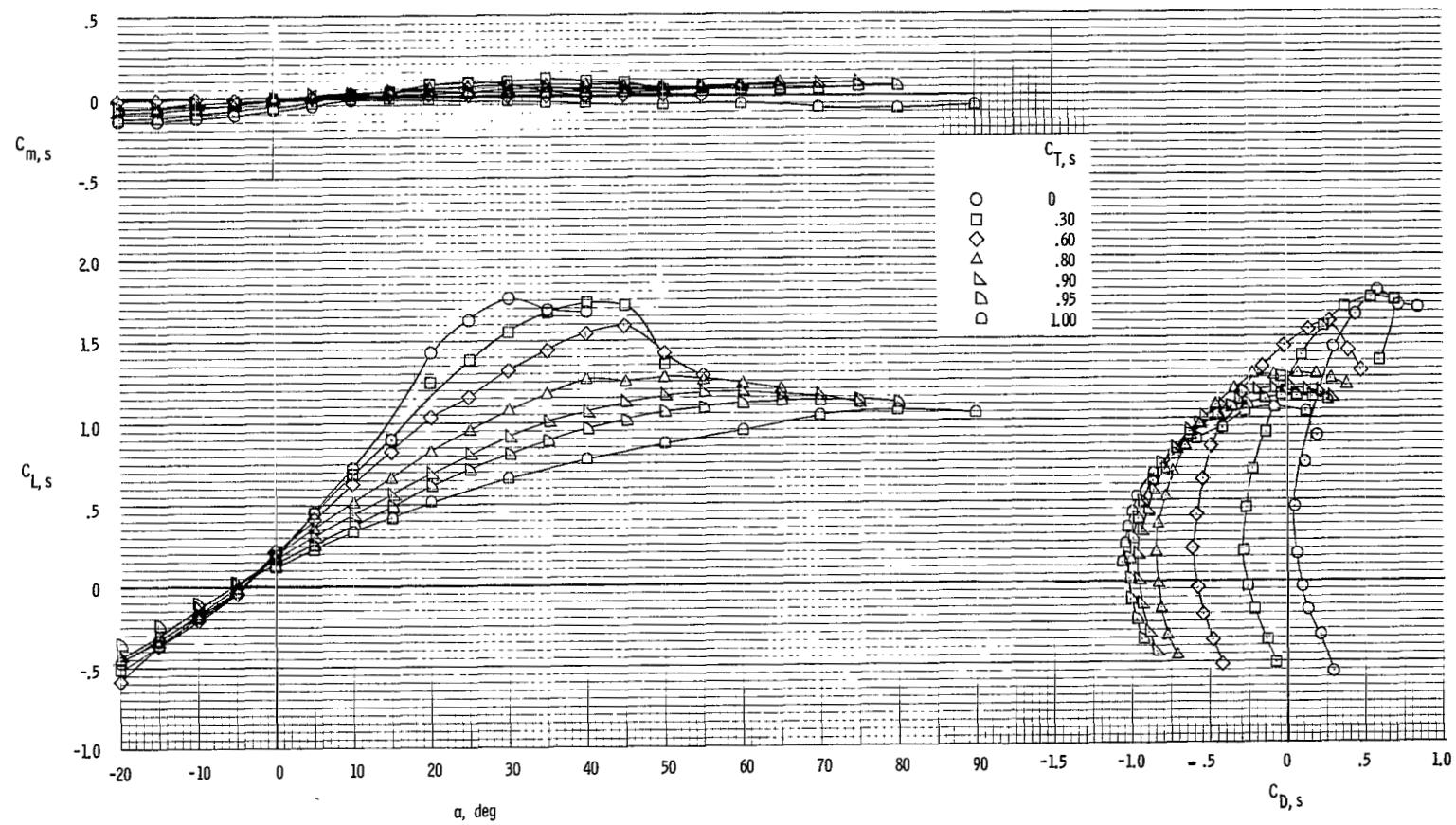
Figure 7.- Continued.



(h) Flow characteristics; $C_{T,s} = 0.$

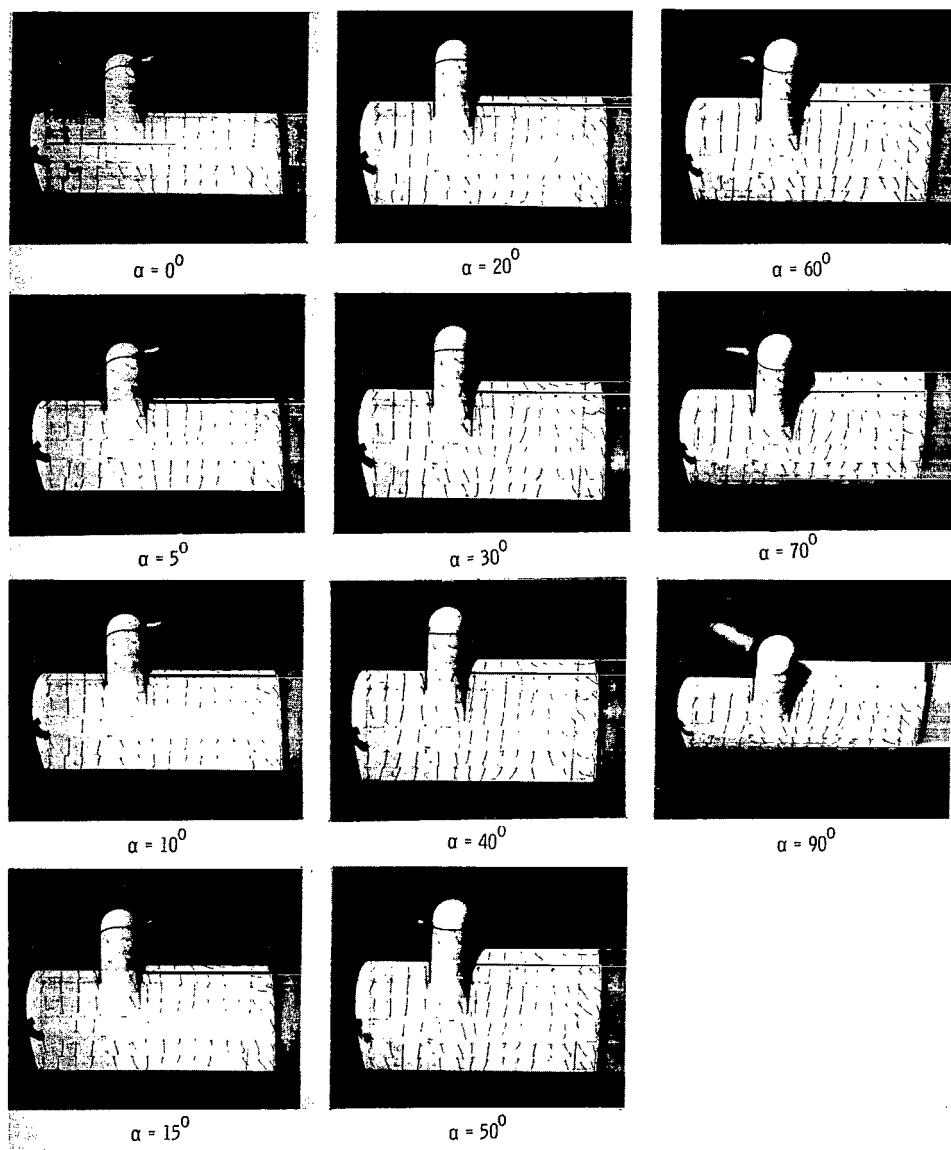
L-64-4428

Figure 7.- Concluded.



(a) Aerodynamic characteristics.

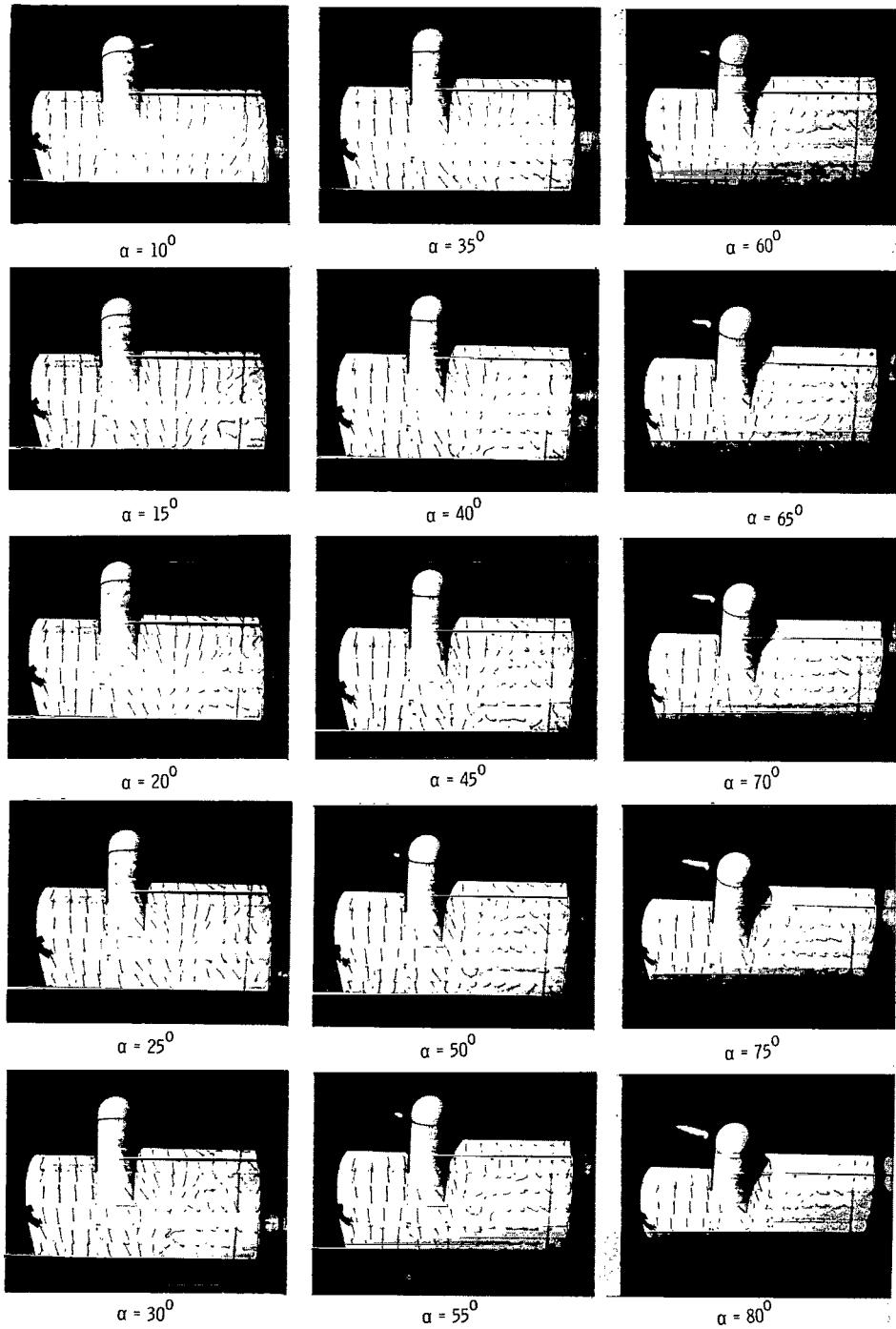
Figure 8.- Aerodynamic and flow characteristics of the model with the inboard section of the leading-edge slat deflected 20° and the trailing-edge flap retracted. $\delta_f = 0^\circ$.



(b) Flow characteristics; $C_{T,s} = 1.00$.

L-64-4429

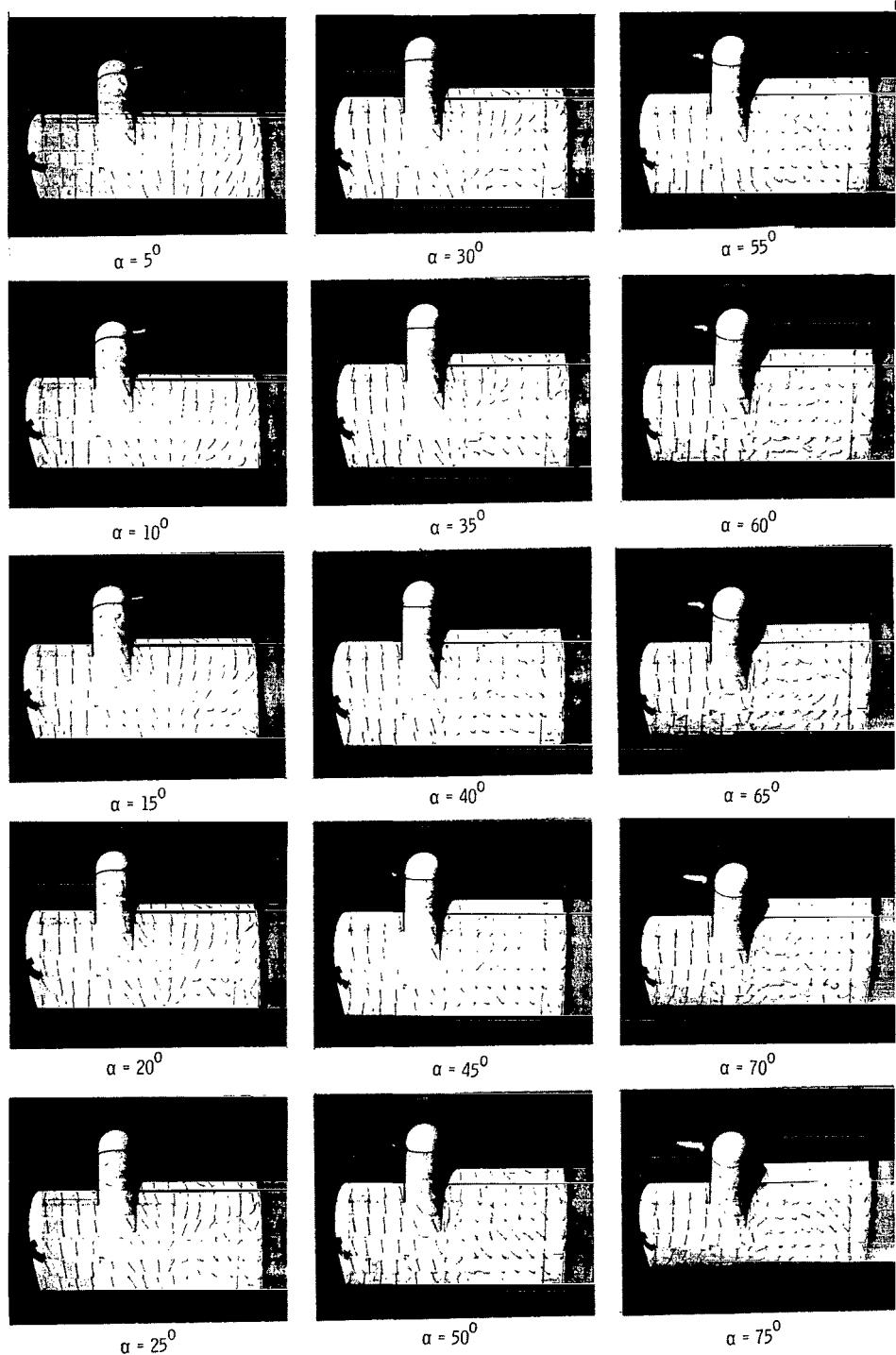
Figure 8.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95.$

L-64-4430

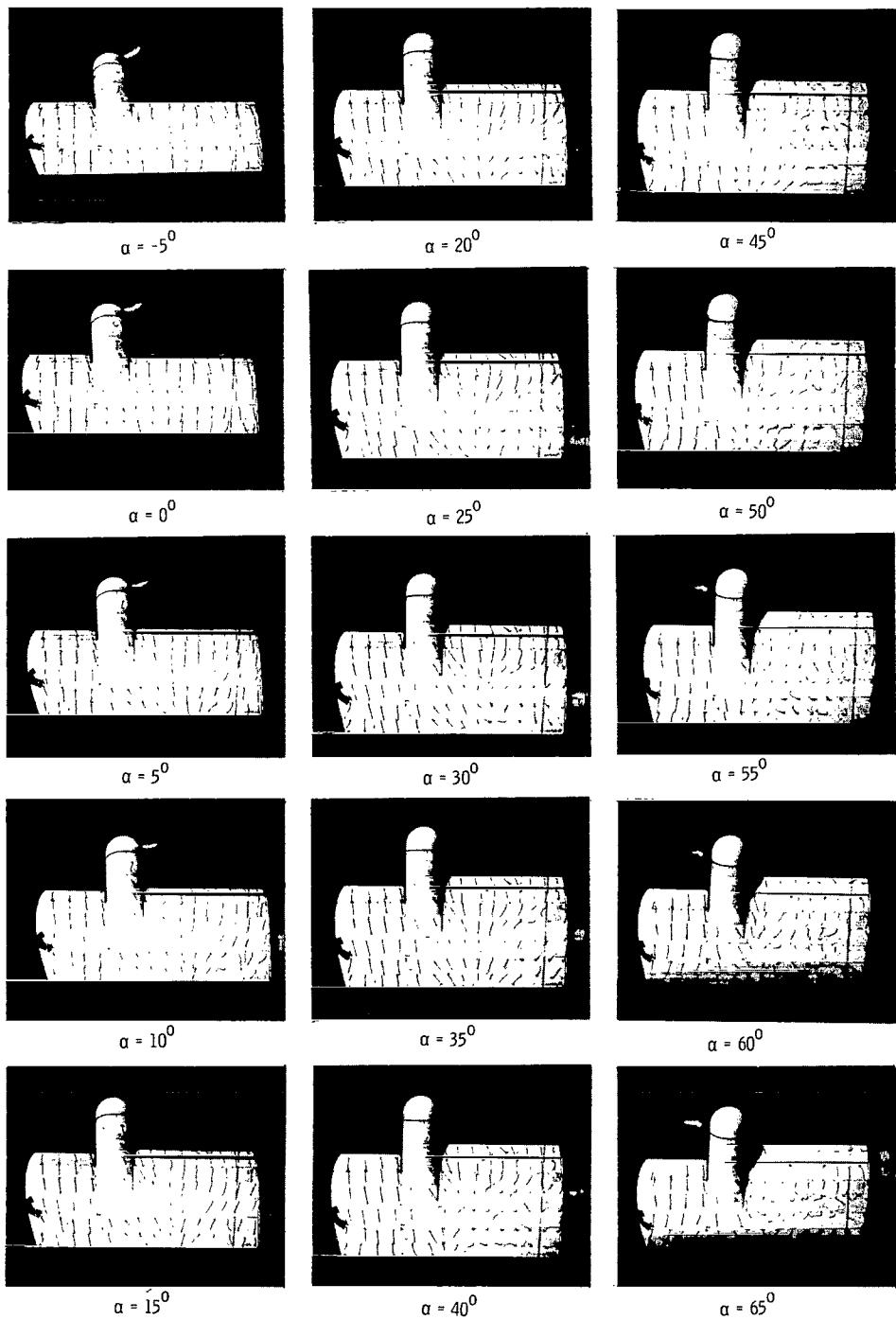
Figure 8.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90.$

L-64-4431

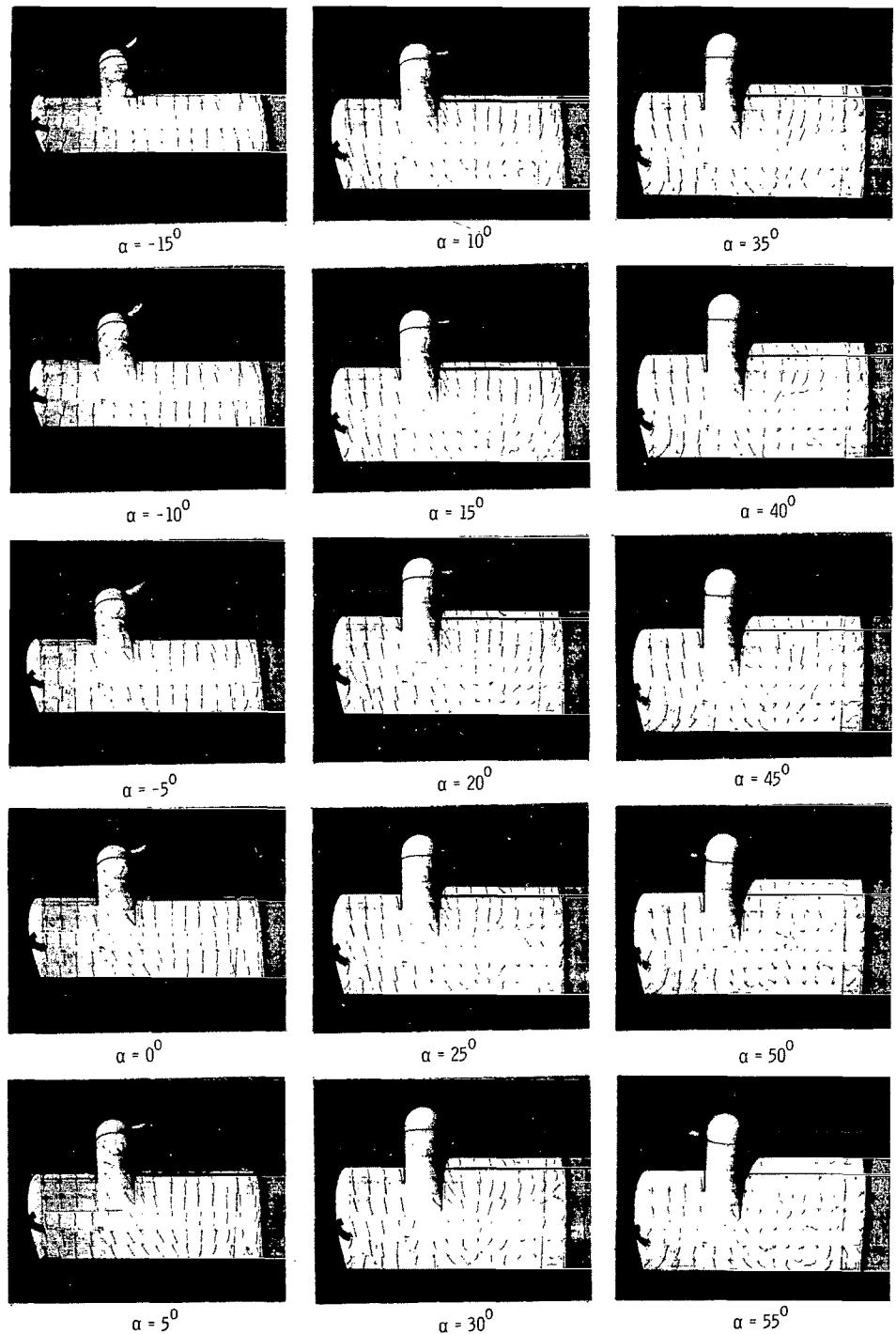
Figure 8.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4432

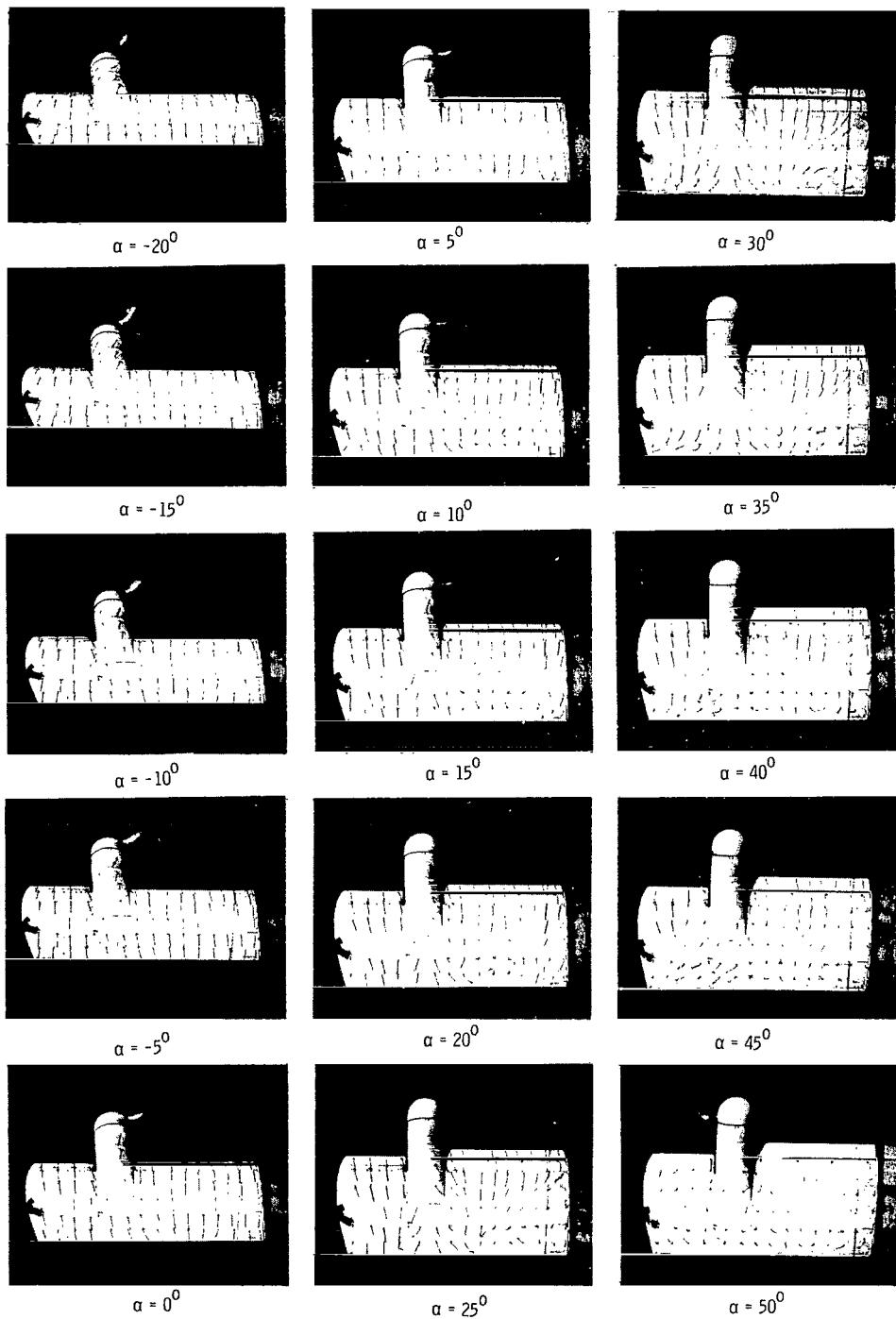
Figure 8.- Continued.



(f) Flow characteristics; $C_{T,S} = 0.60$.

L-64-4433

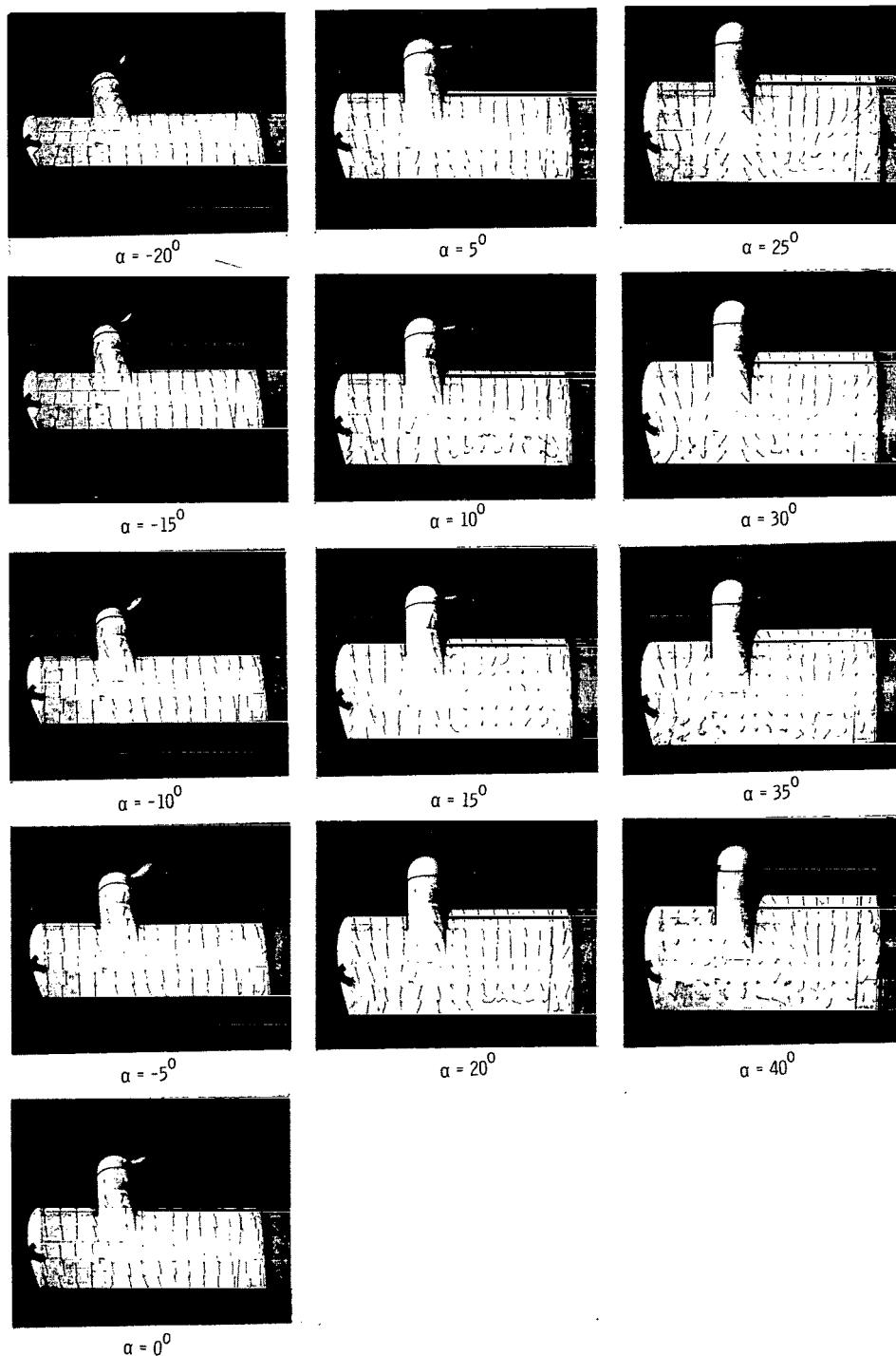
Figure 8.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30$.

L-64-4434

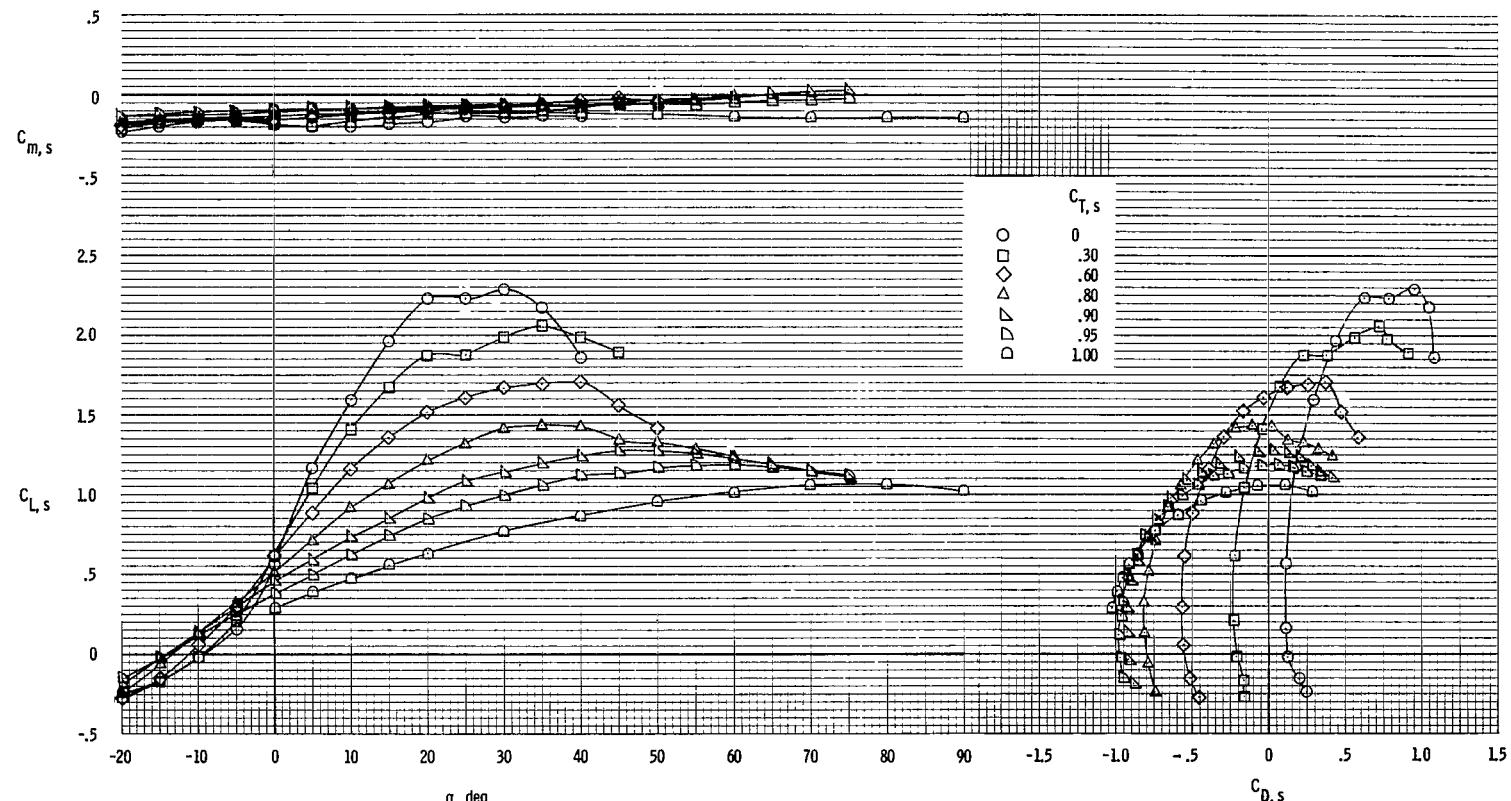
Figure 8.- Continued.



(h) Flow characteristics; $C_{T,s} = 0.$

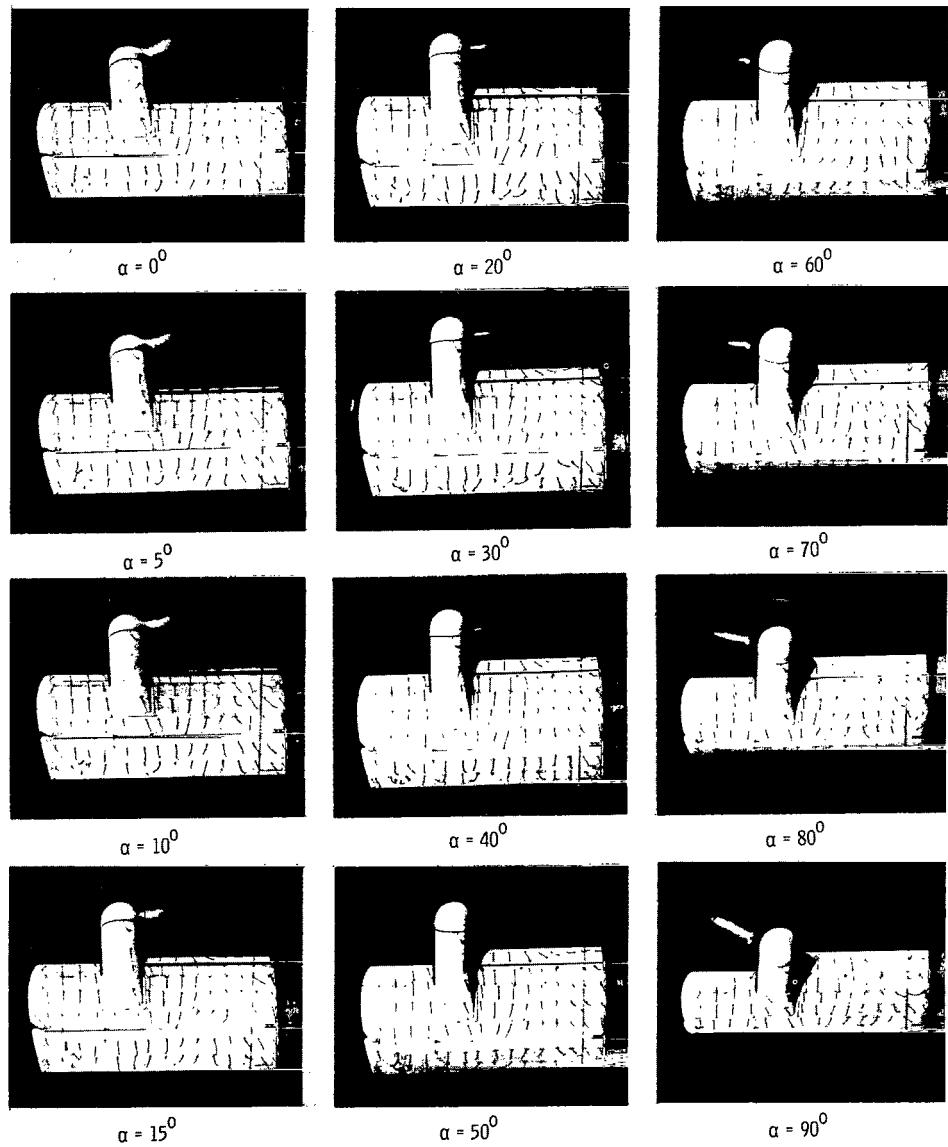
L-64-4435

Figure 8.- Concluded.



(a) Aerodynamic characteristics.

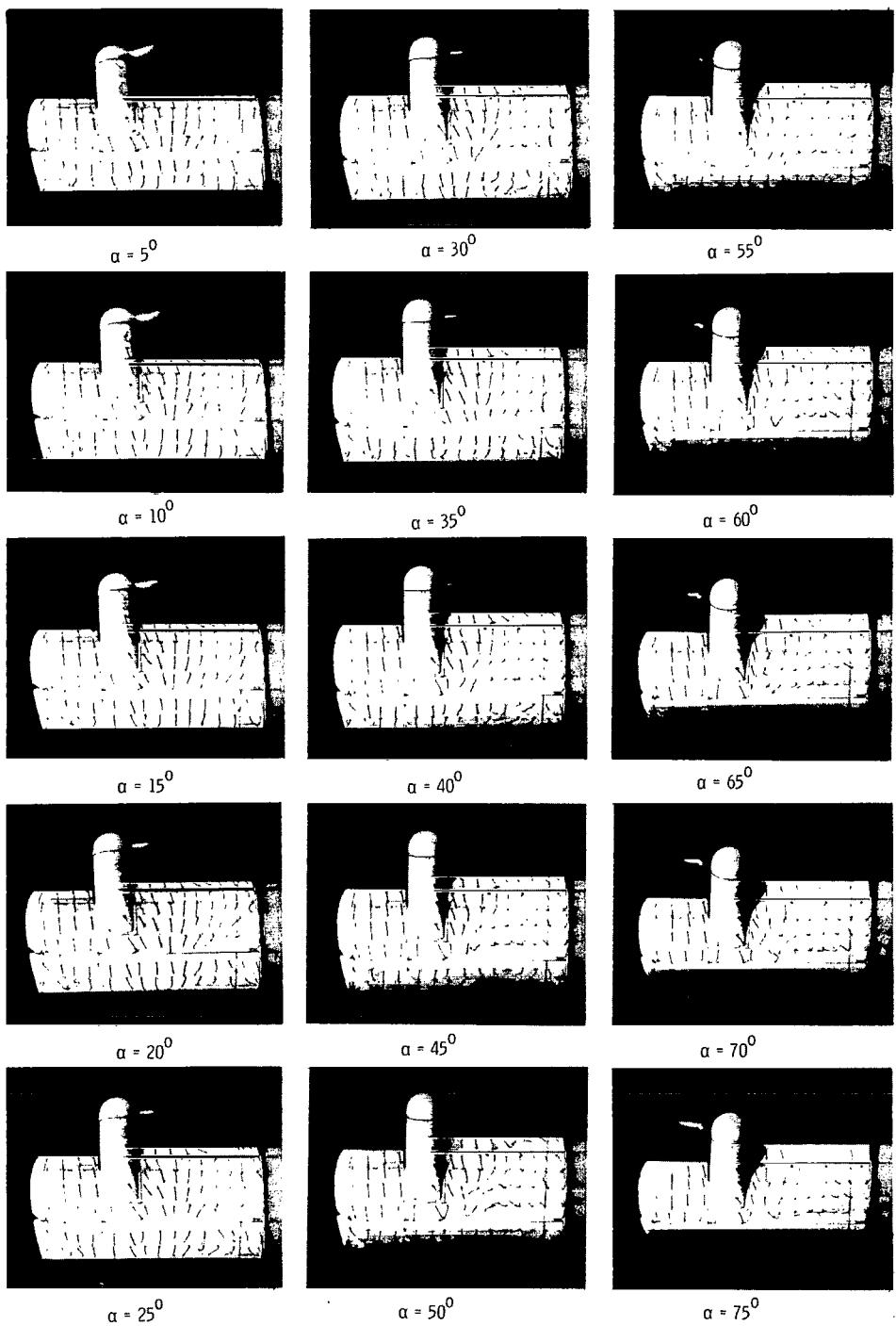
Figure 9.- Aerodynamic and flow characteristics of the model with the inboard section of the leading-edge slat deflected 20° and the trailing-edge flap deflected. $\delta_f = 20^\circ$.



(b) Flow characteristics; $C_{T,s} = 1.00.$

L-64-4436

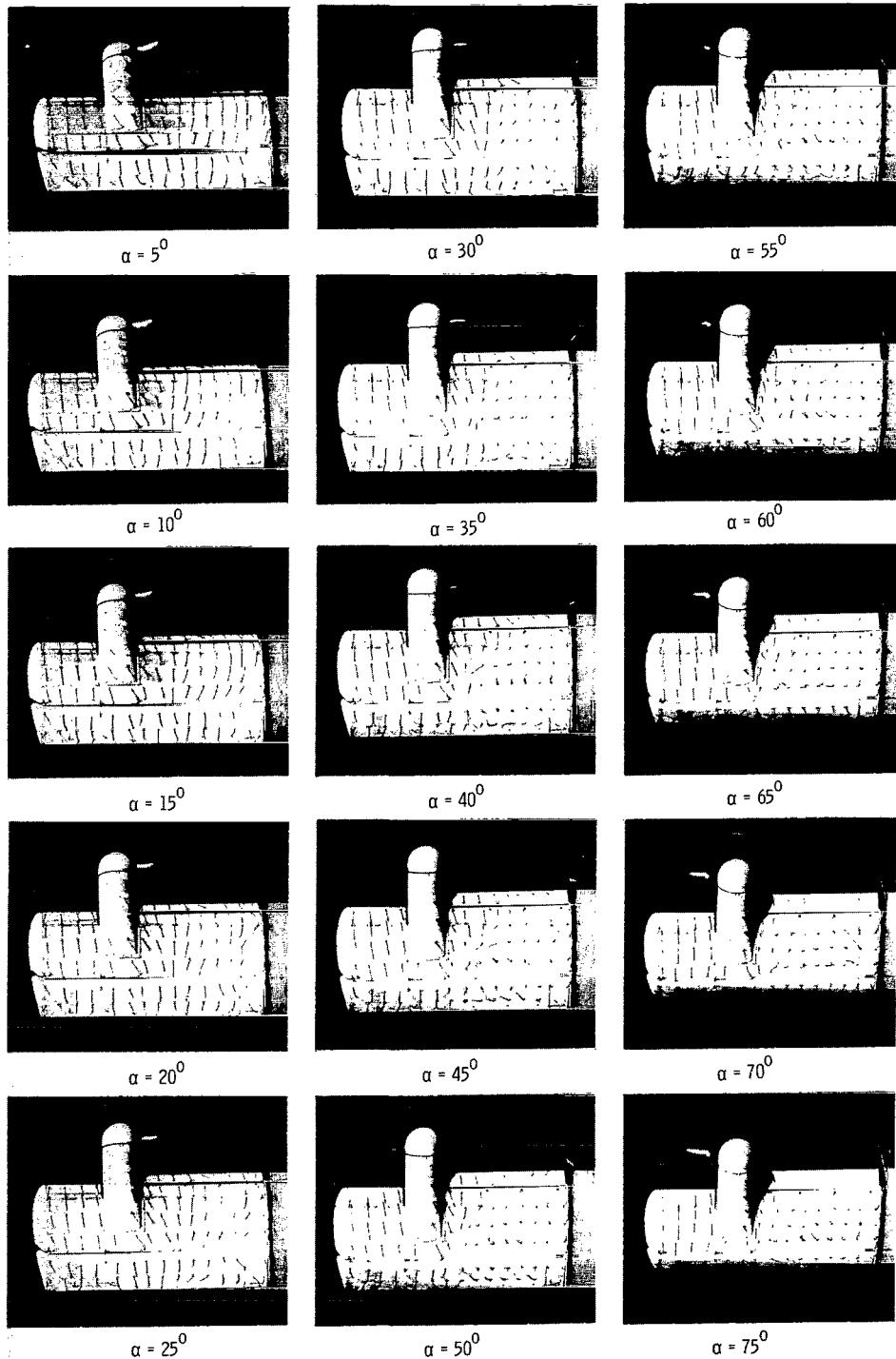
Figure 9.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4437

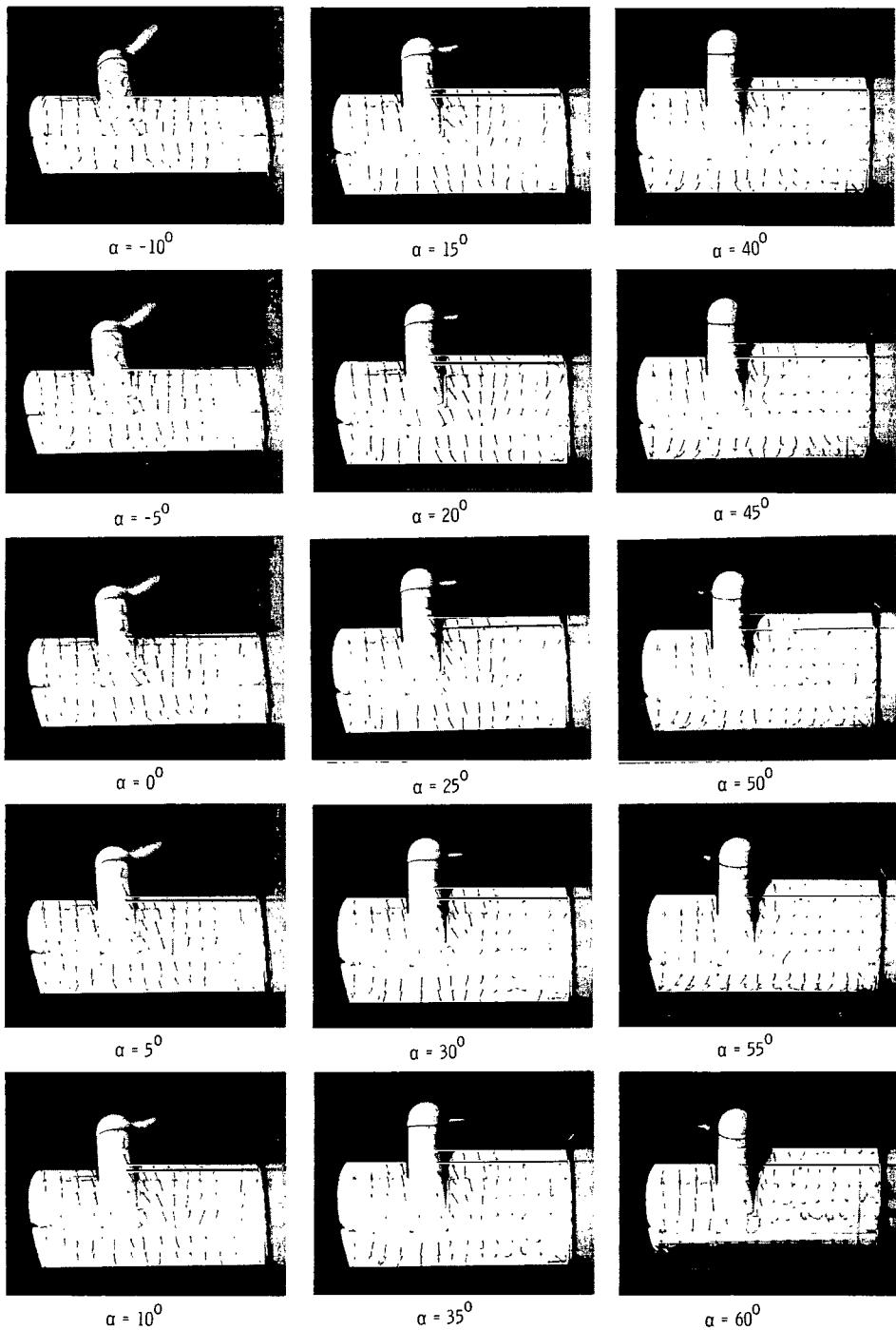
Figure 9.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90.$

L-64-4438

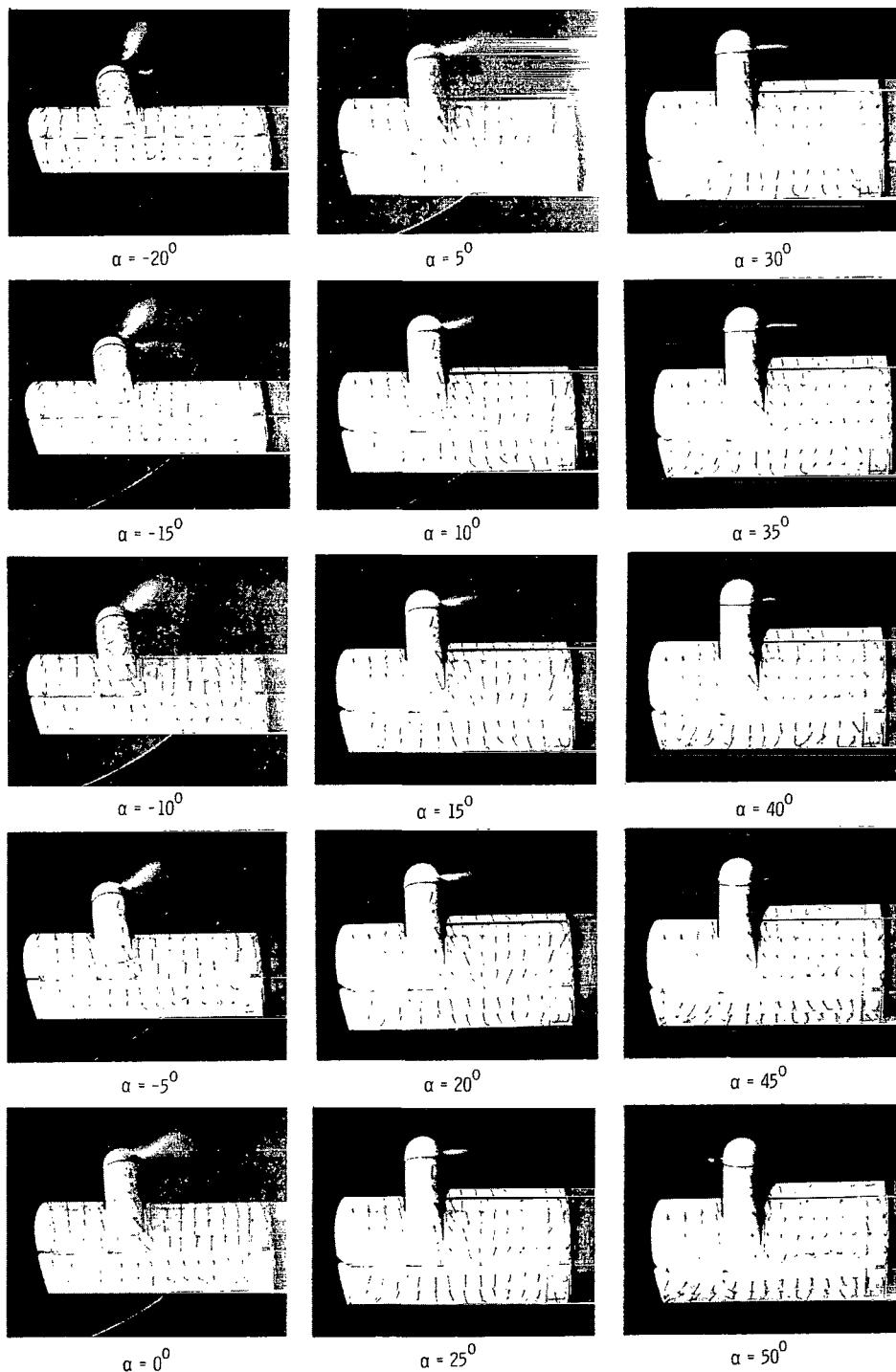
Figure 9.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80$.

L-64-4439

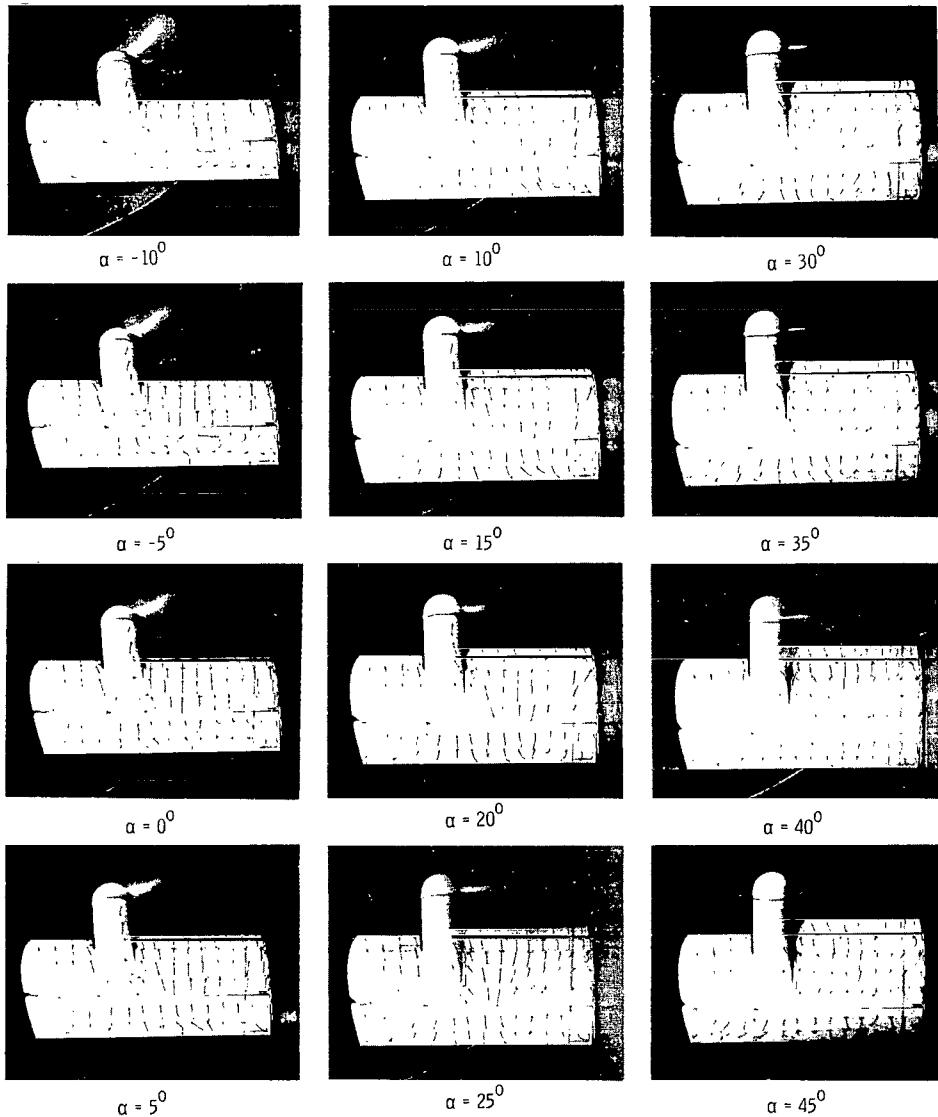
Figure 9.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60$.

L-64-4440

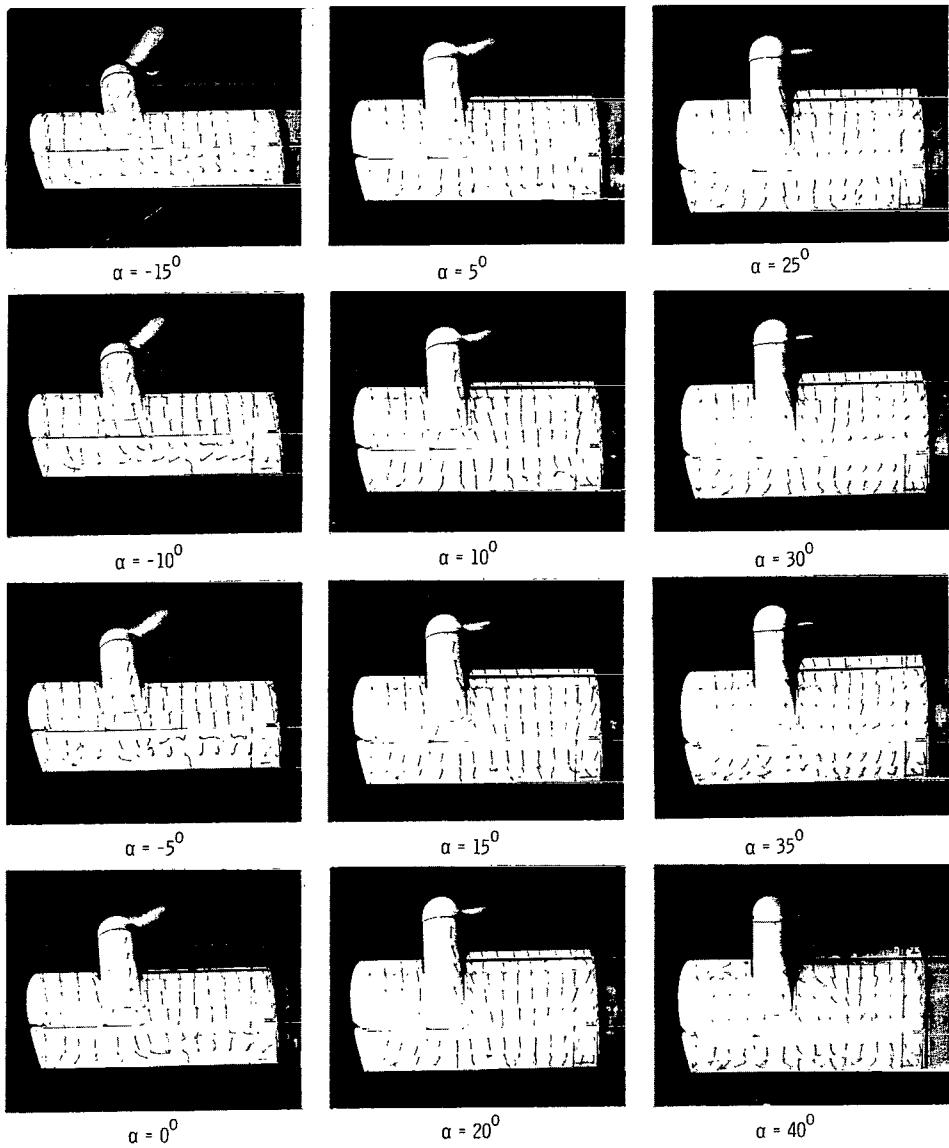
Figure 9..- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30$.

L-64-4441

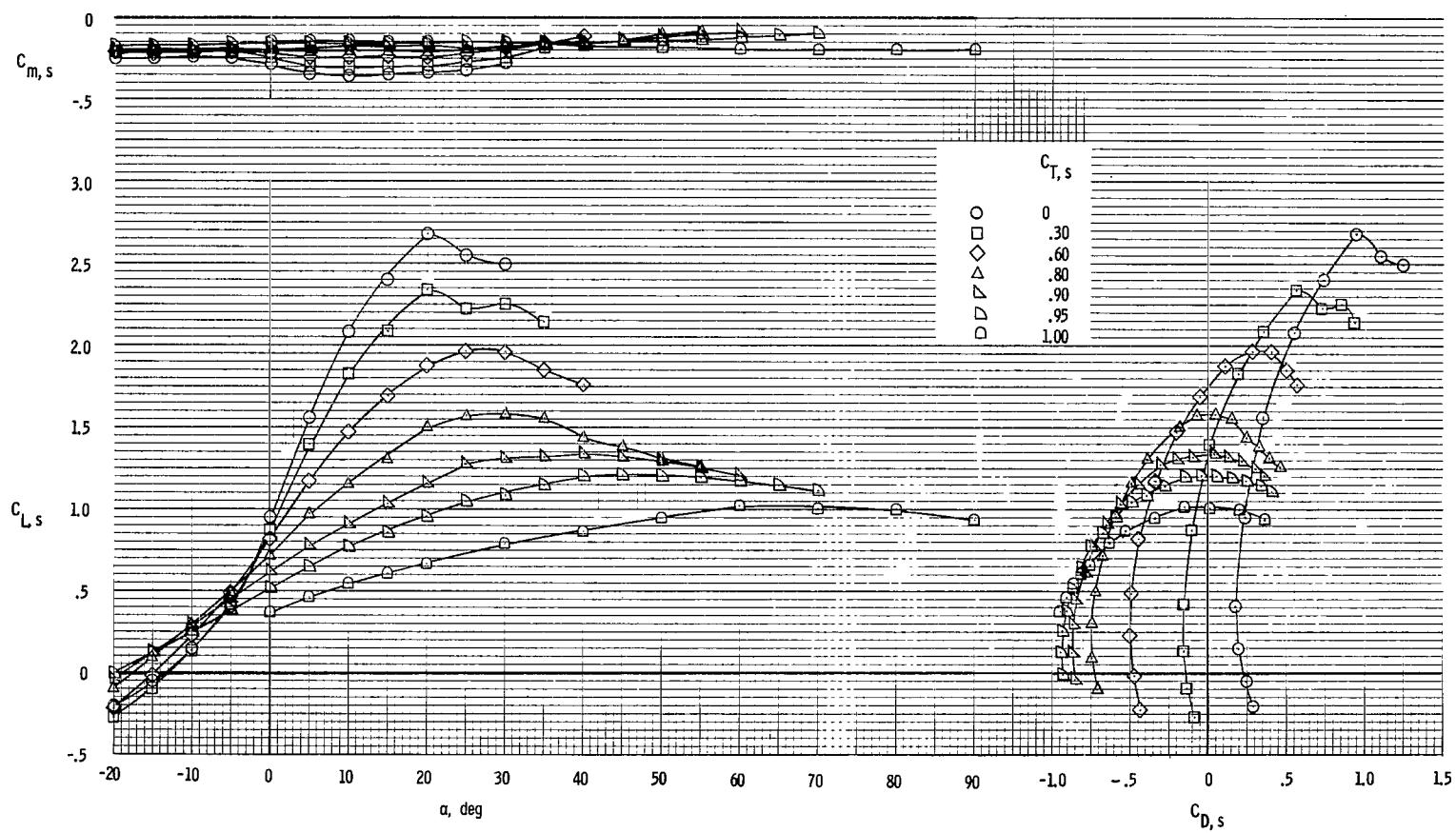
Figure 9.- Continued.



(h) Flow characteristics; $C_{T,s} = 0.$

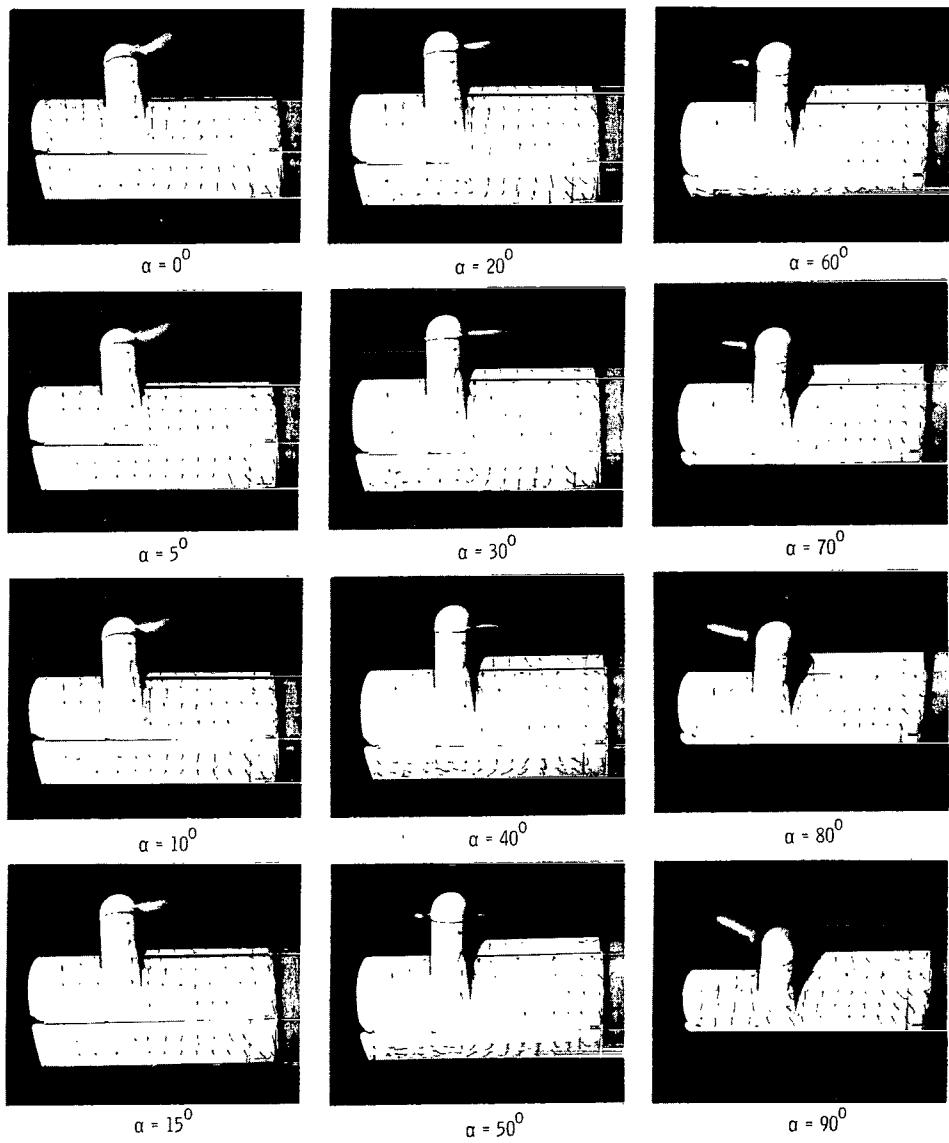
L-64-4442

Figure 9.- Concluded.



(a) Aerodynamic characteristics.

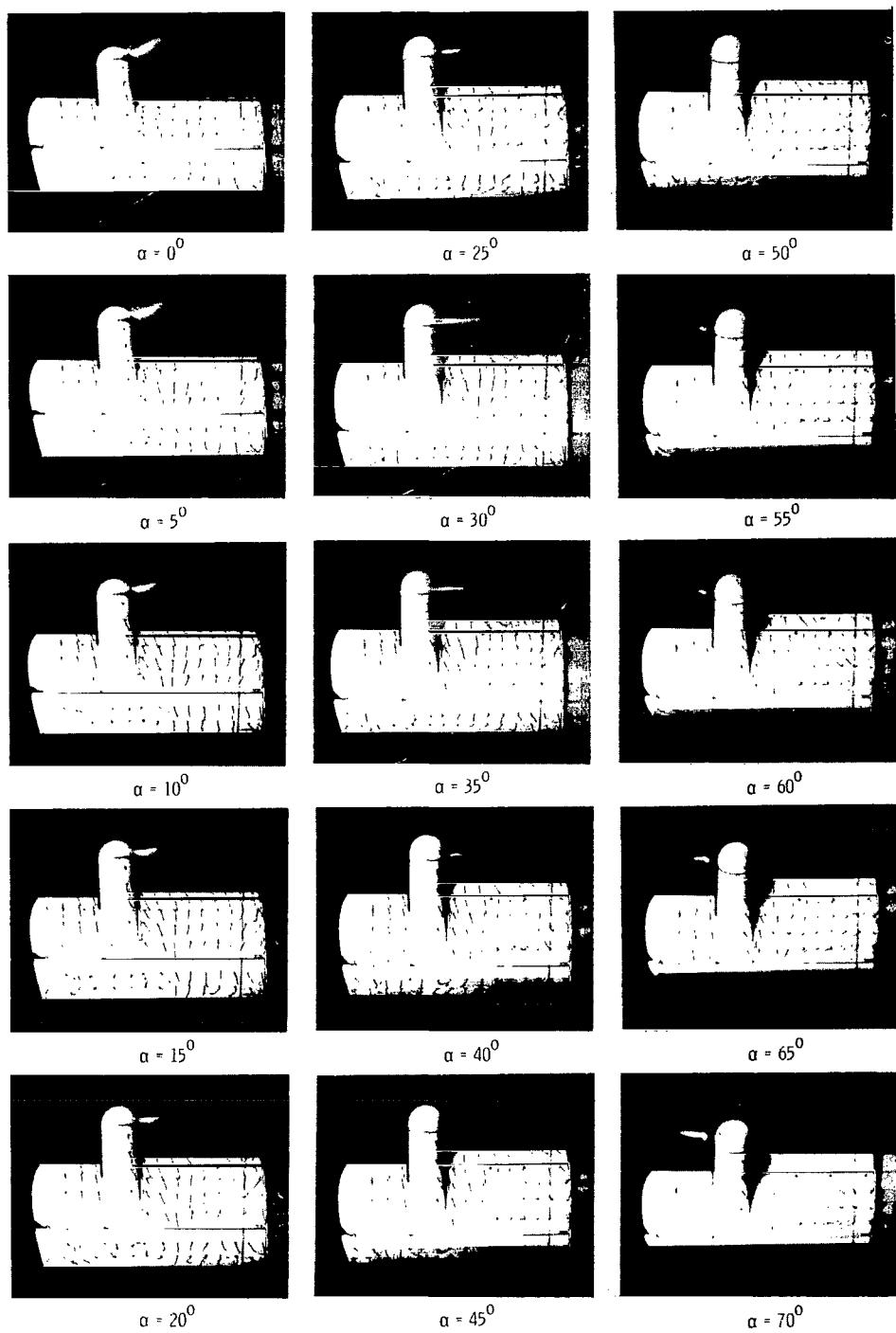
Figure 10.- Aerodynamic and flow characteristics of the model with the inboard section of the leading-edge slat deflected 20° and the trailing-edge flap deflected. $\delta_f = 40^\circ$.



(b) Flow characteristics; $C_{T,s} = 1.00$.

L-64-4443

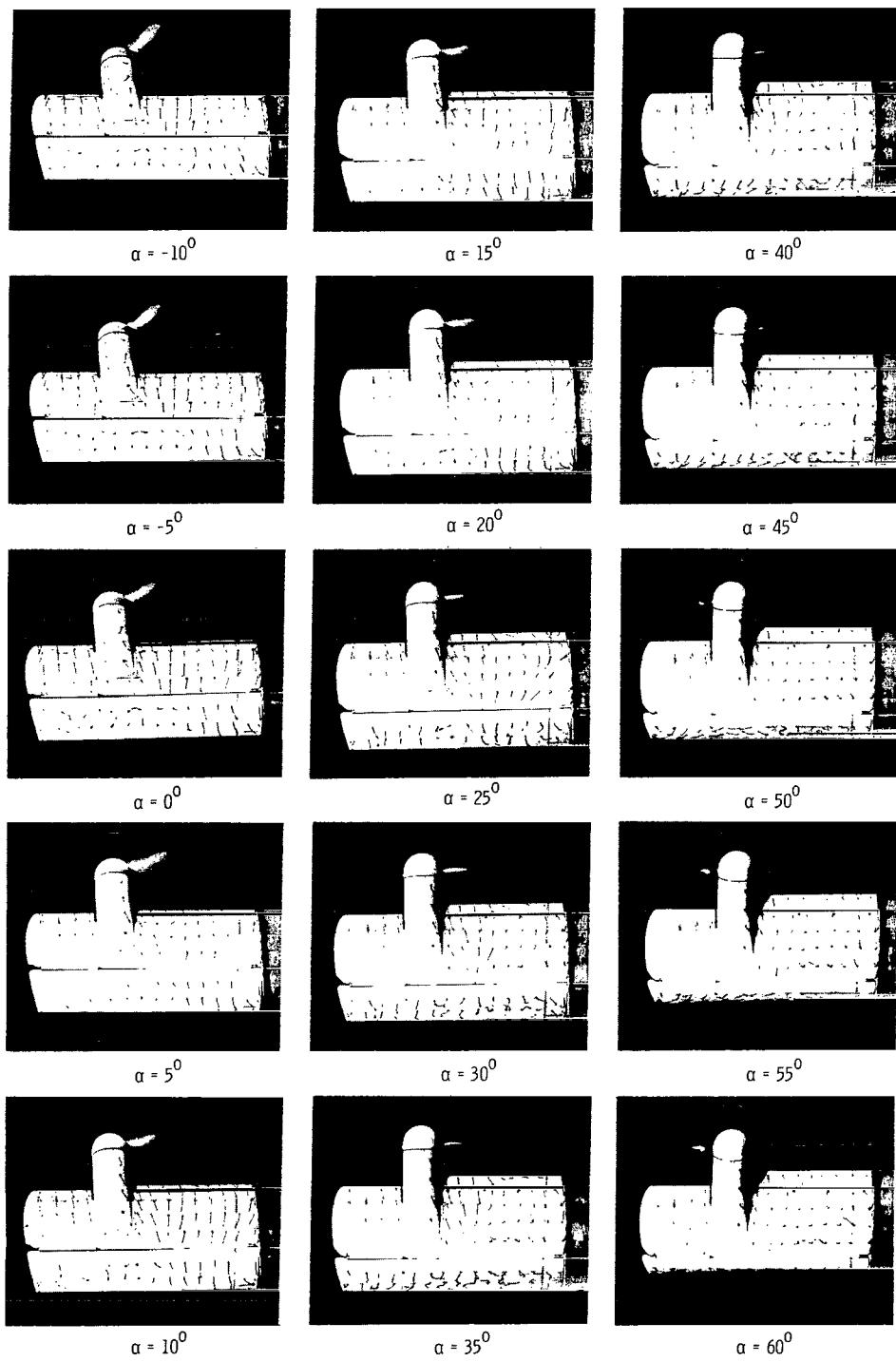
Figure 10.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4444

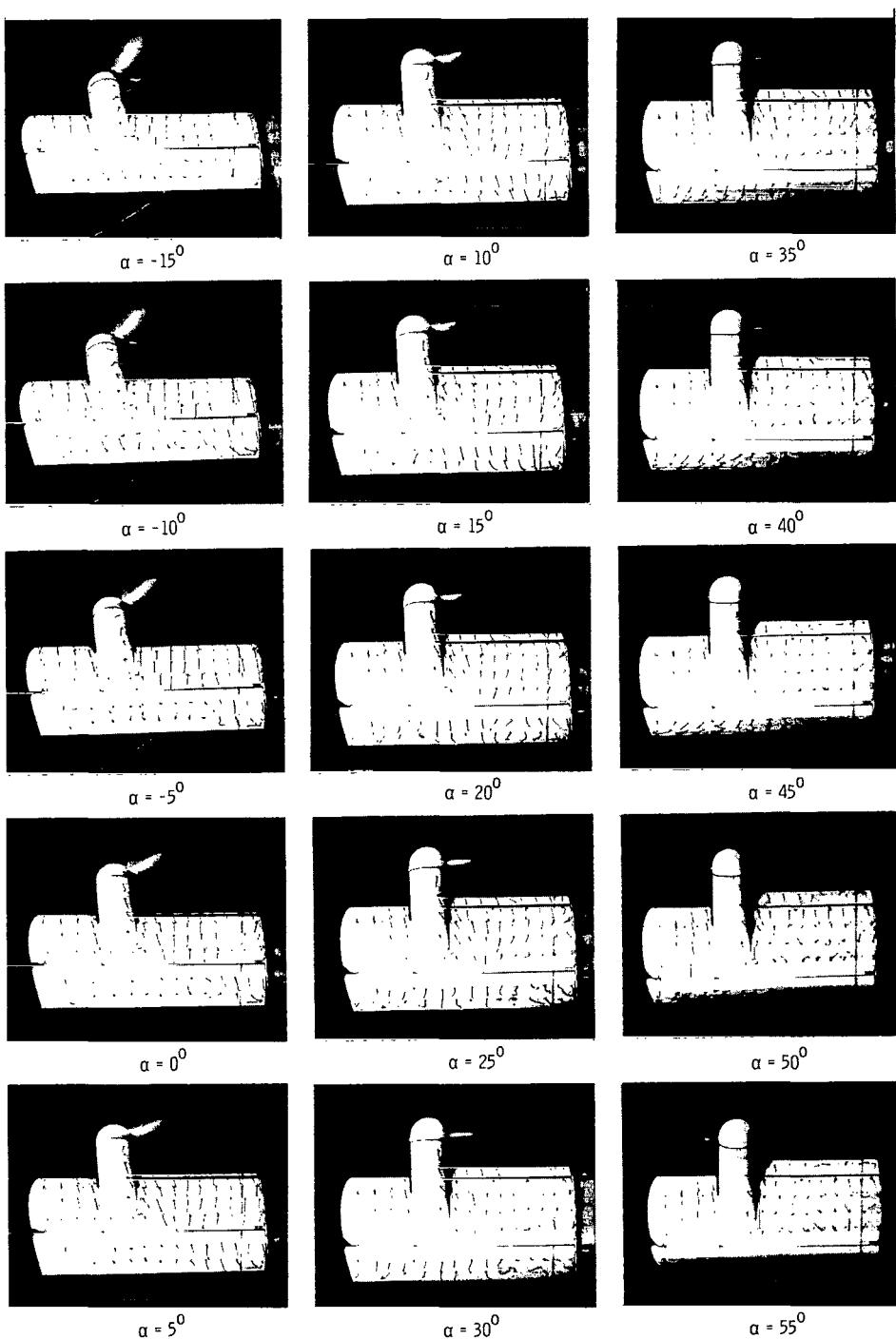
Figure 10.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4445

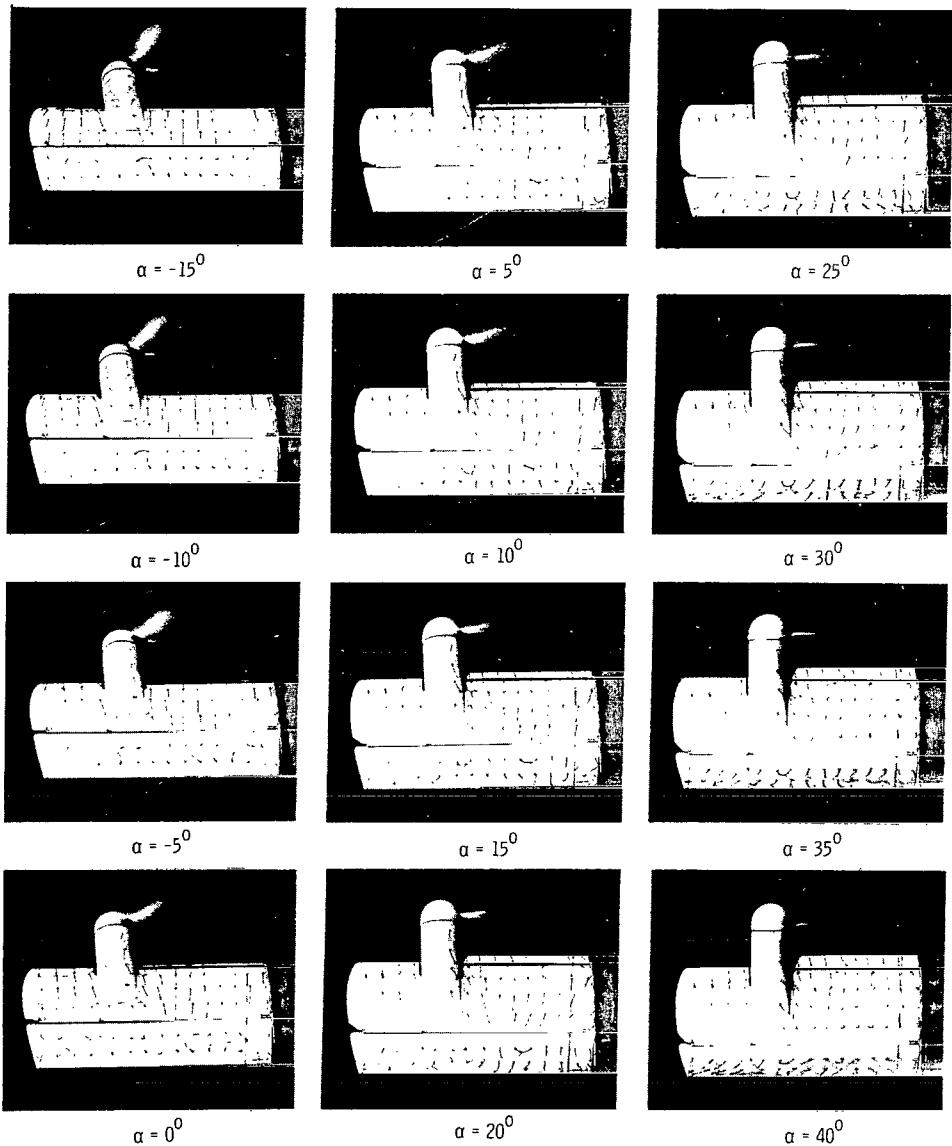
Figure 10.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80$.

L-64-4446

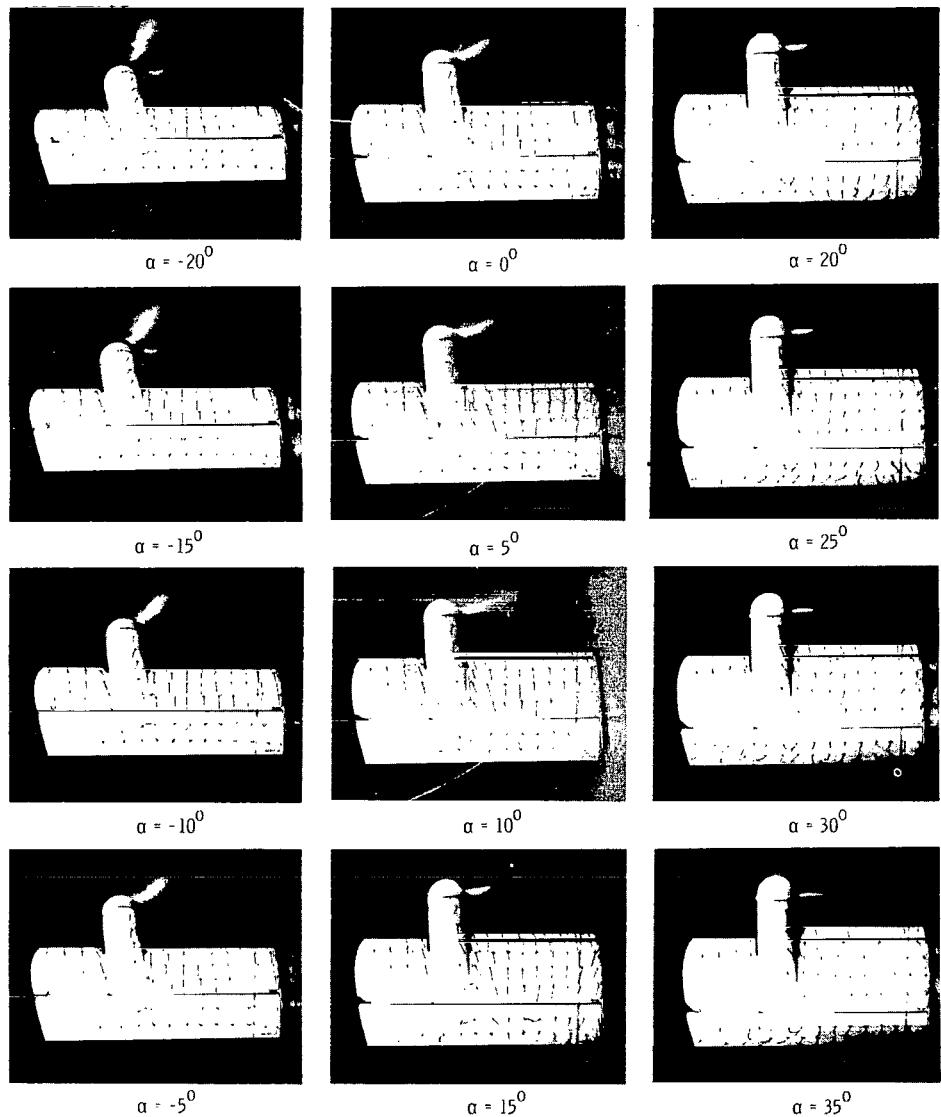
Figure 10.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60$.

L-64-4447

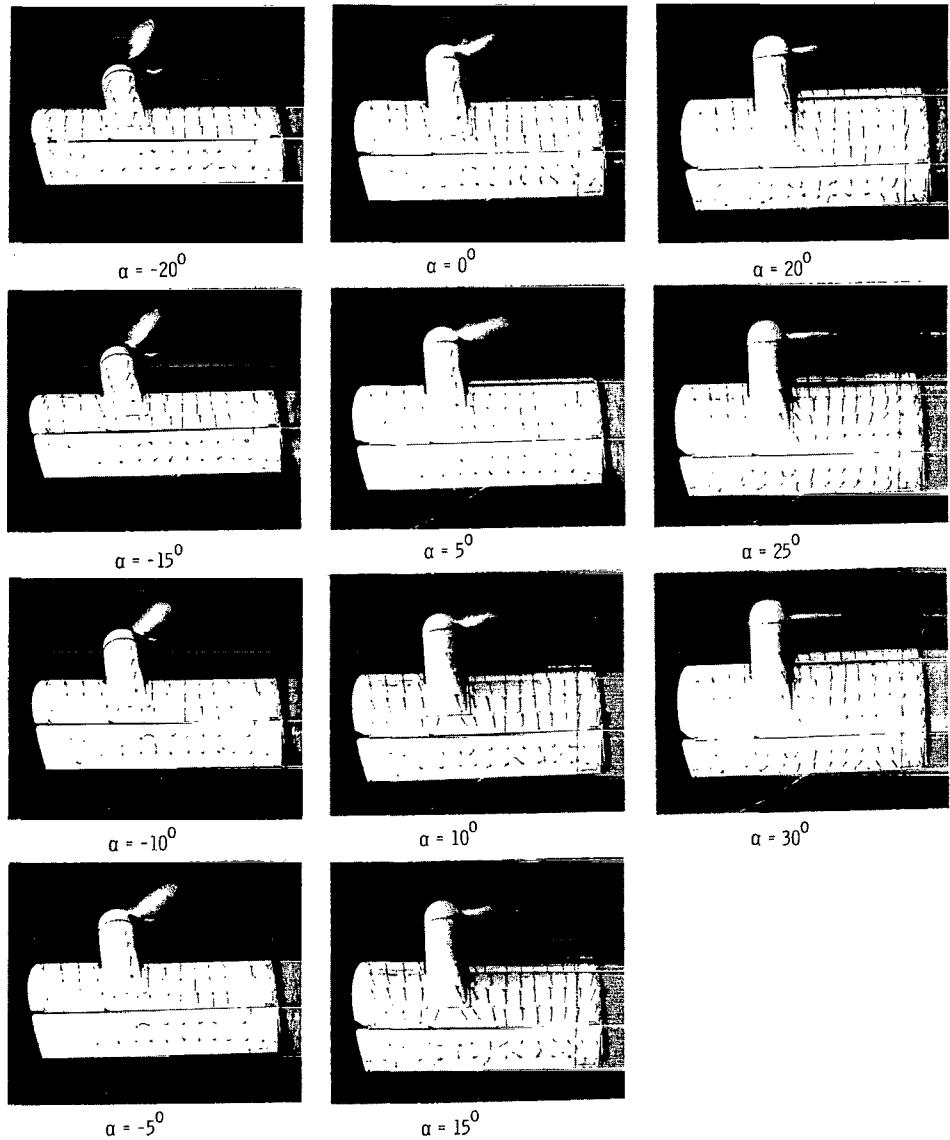
Figure 10.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30.$

L-64-4448

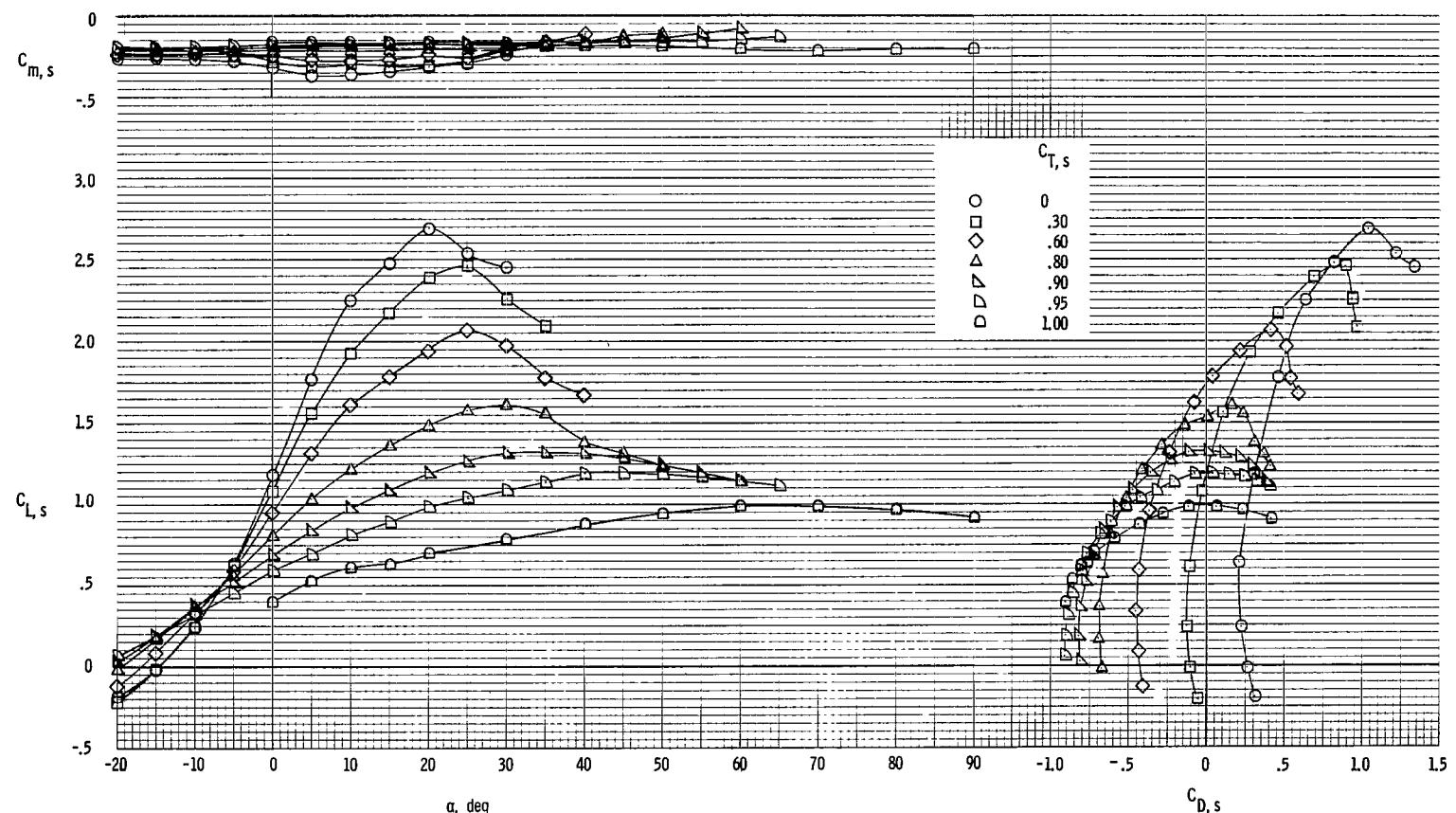
Figure 10.- Continued.



(h) Flow characteristics; $C_{T,s} = 0$.

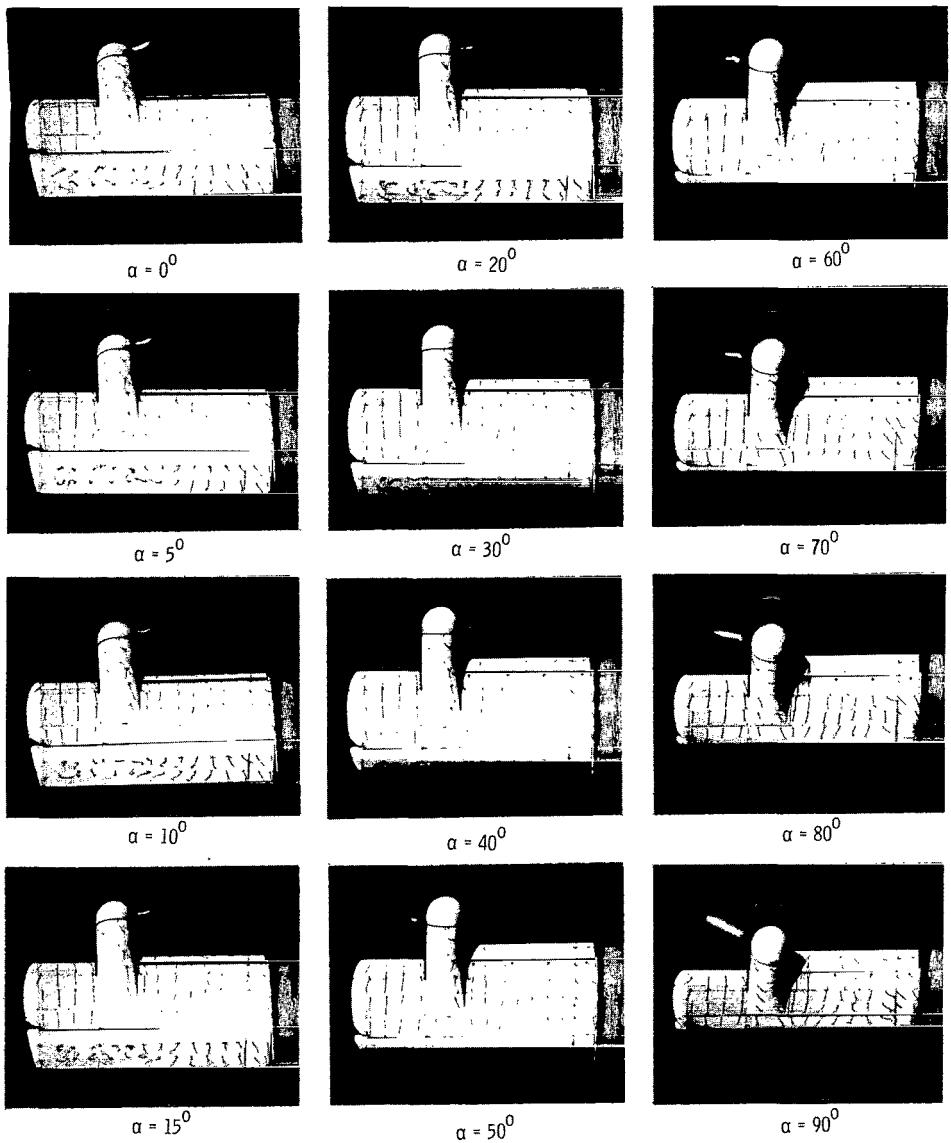
L-64-4449

Figure 10.- Concluded.



(a) Aerodynamic characteristics.

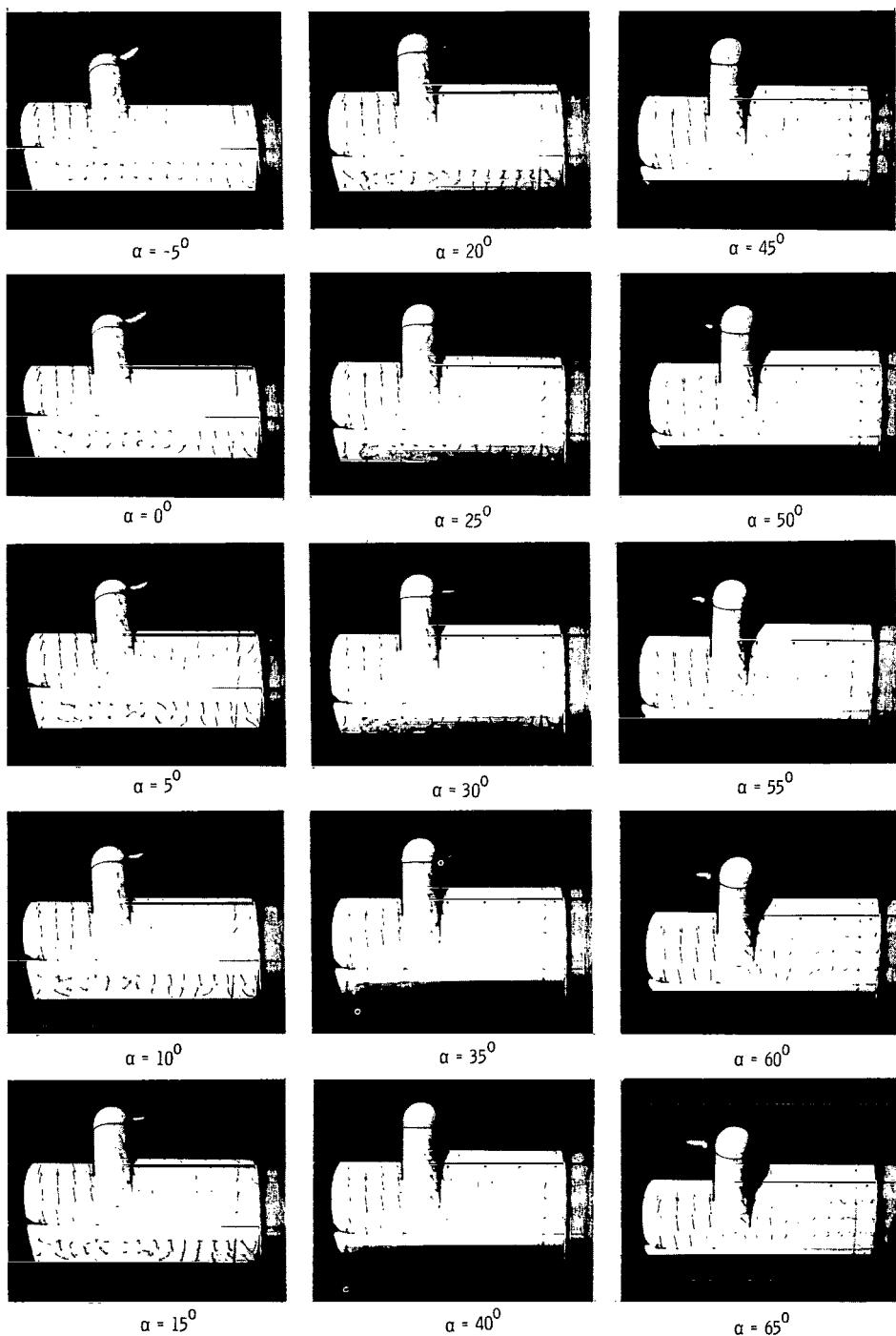
Figure 11.- Aerodynamic and flow characteristics of the model with the inboard section of the leading-edge slat deflected 20° and the trailing-edge flap deflected. $\delta_f = 50^\circ$.



(b) Flow characteristics; $C_{T,s} = 1.00.$

L-64-4450

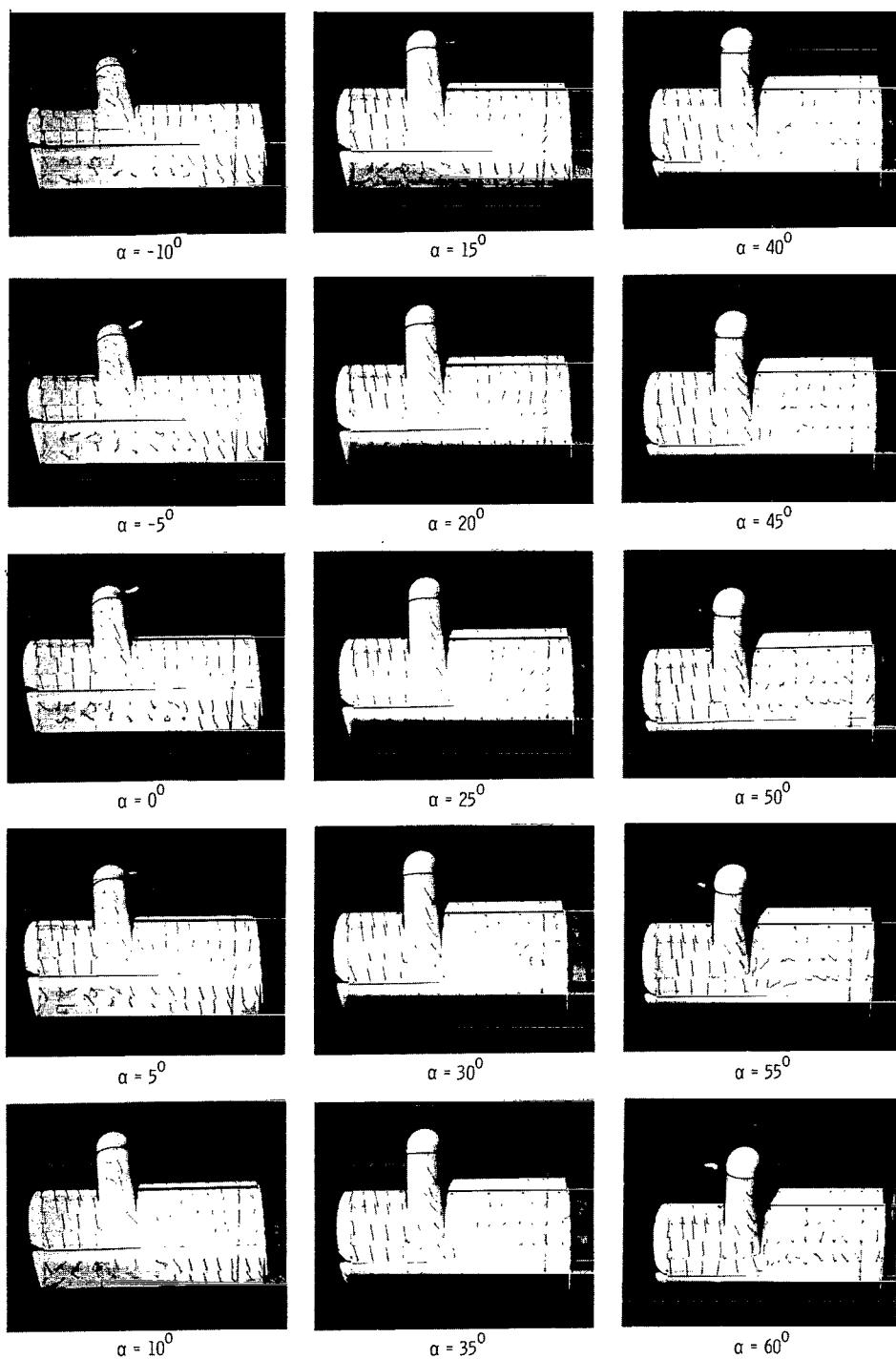
Figure 11.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4451

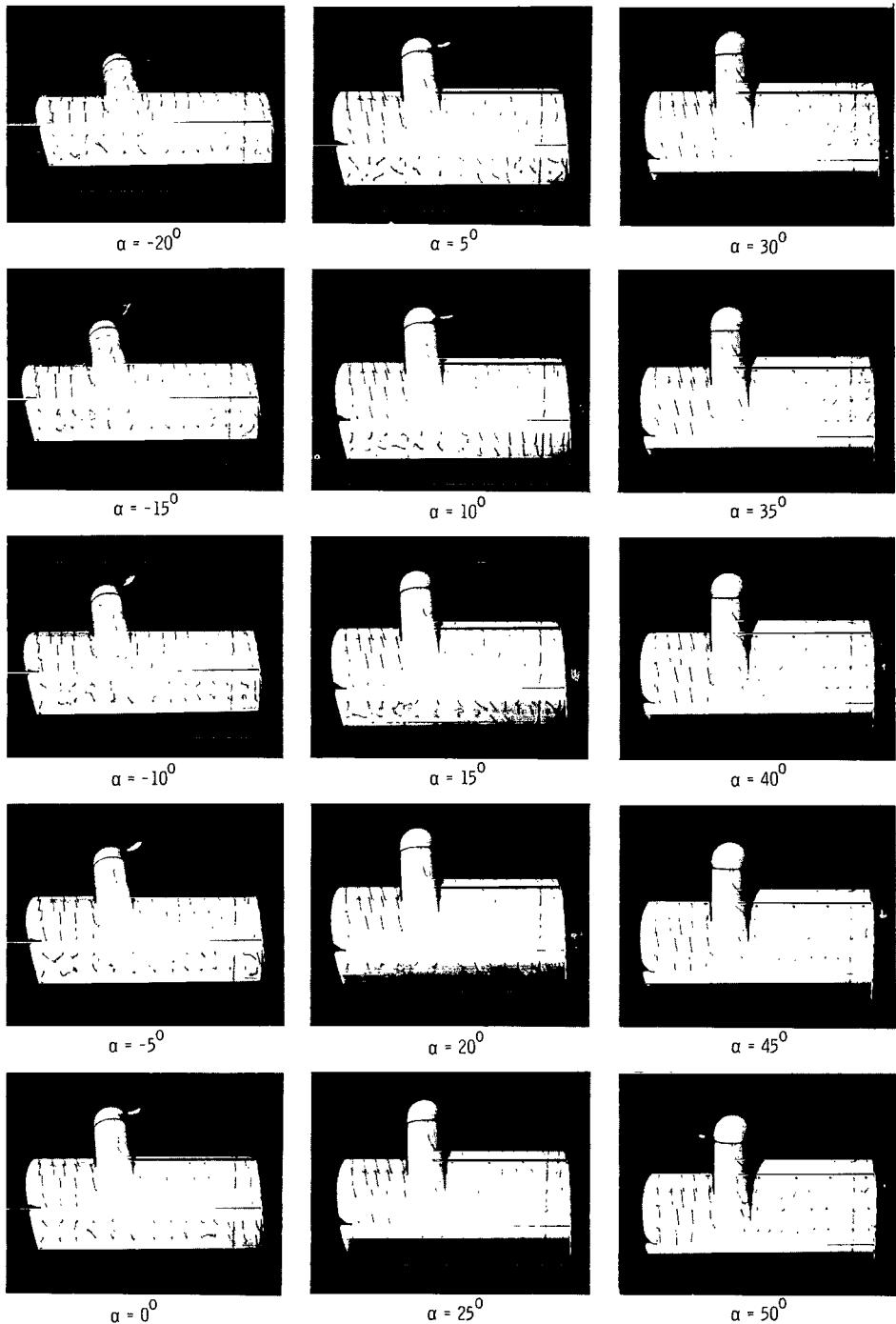
Figure 11.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4452

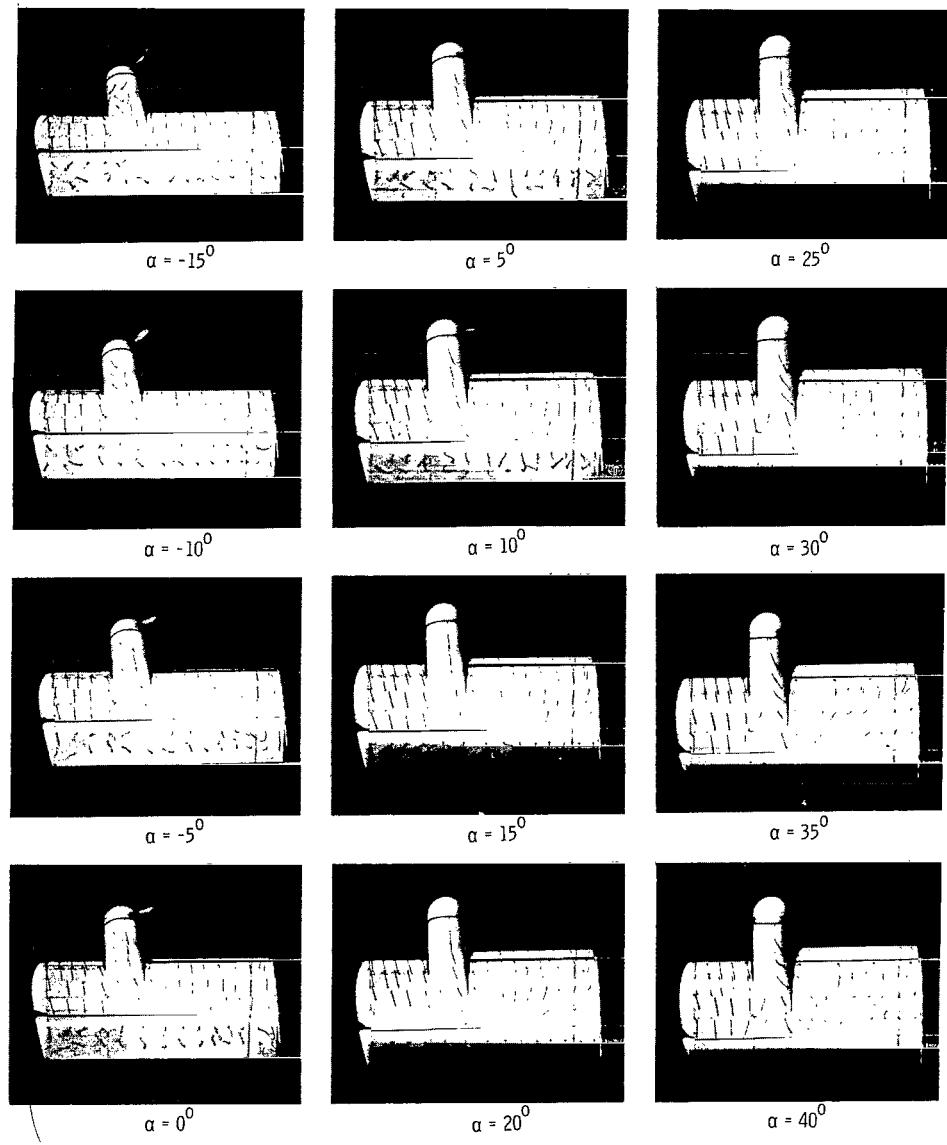
Figure 11--Continued.



(e) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4453

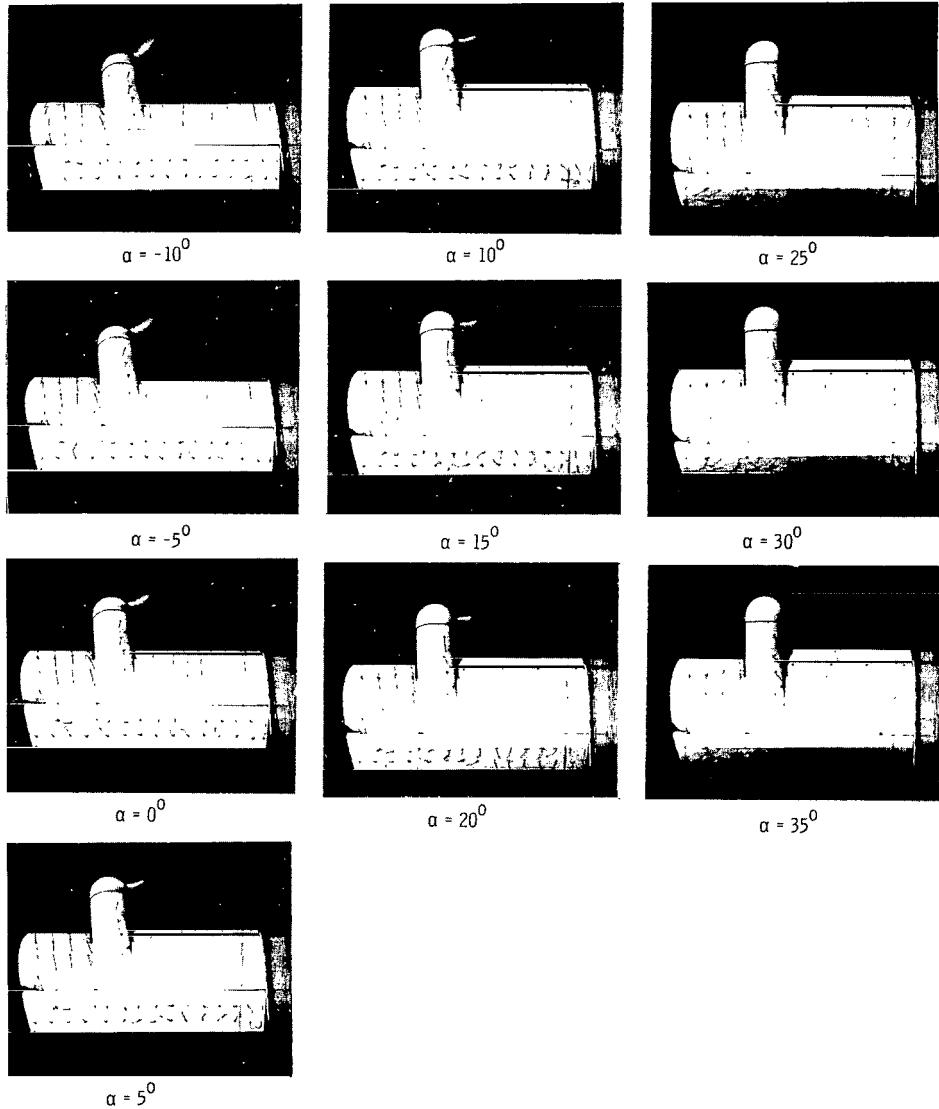
Figure 11.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60$.

L-64-4454

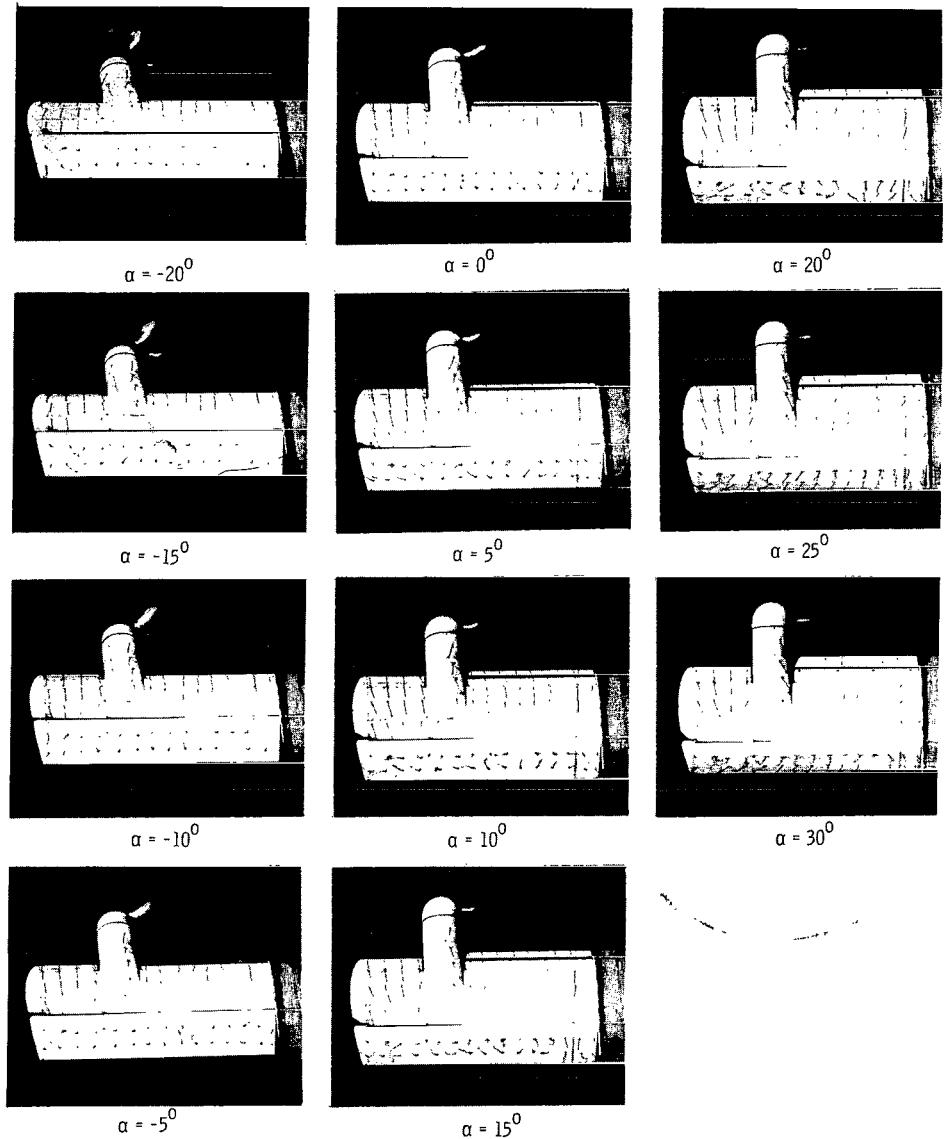
Figure 11.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30$.

L-64-4455

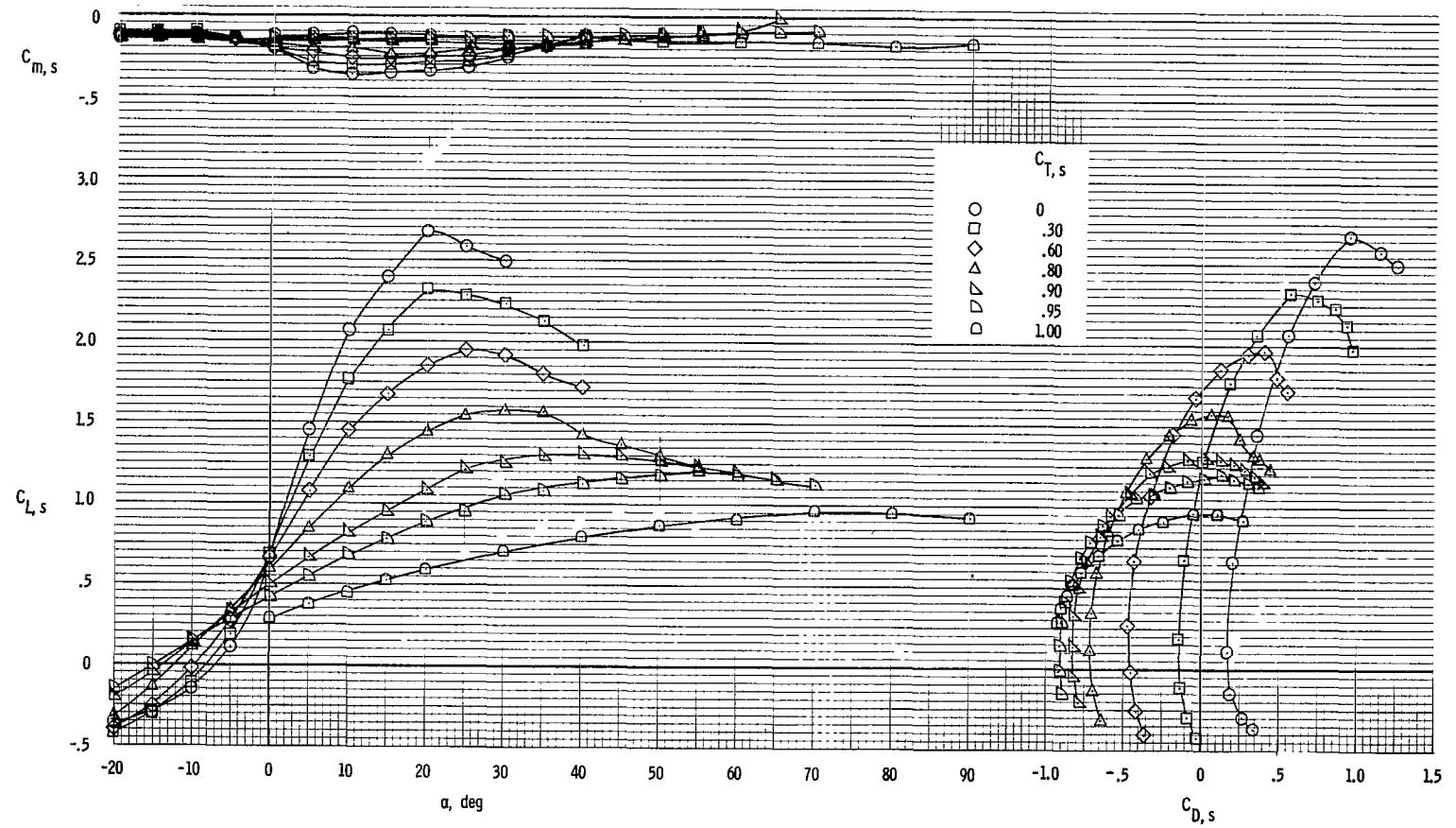
Figure 11.- Continued.



(h) Flow characteristics; $C_{T,s} = 0.$

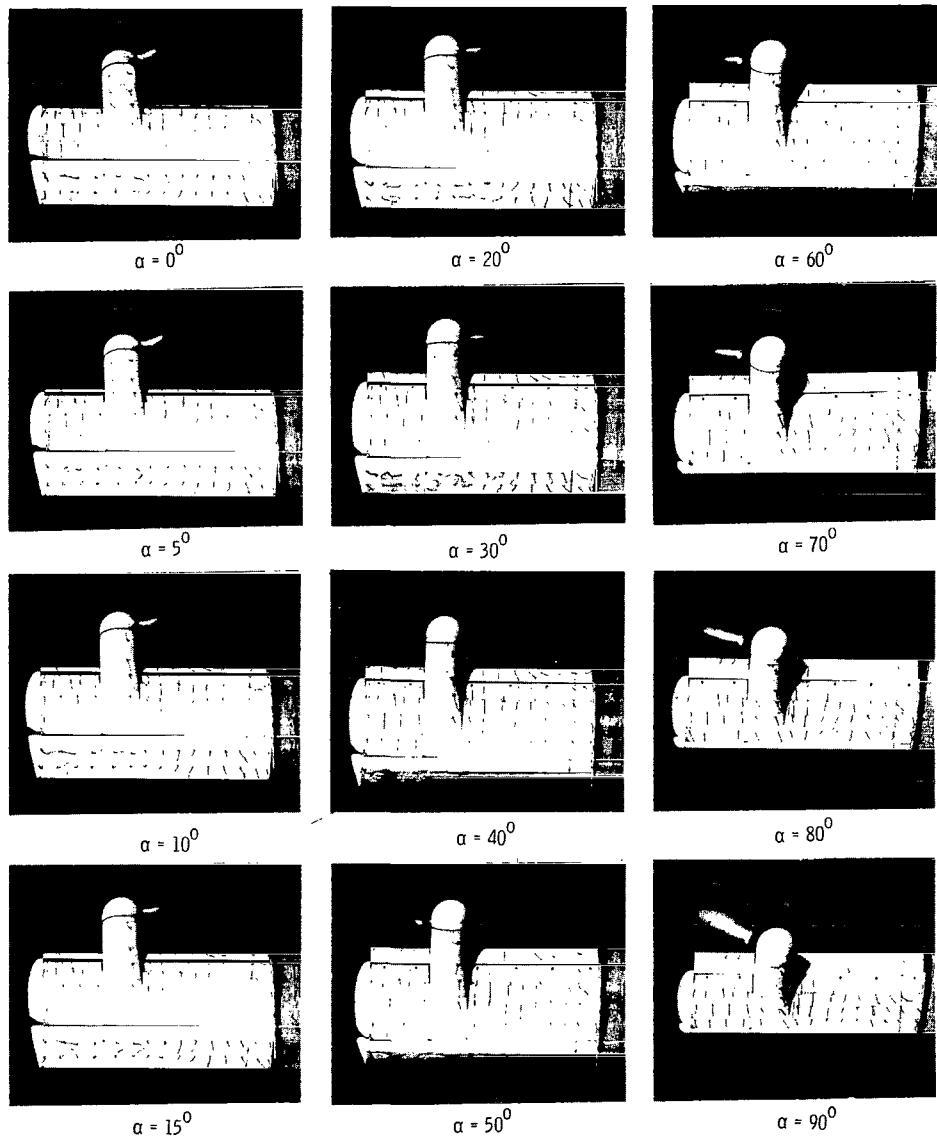
L-64-4456

Figure 11.- Concluded.



(a) Aerodynamic characteristics.

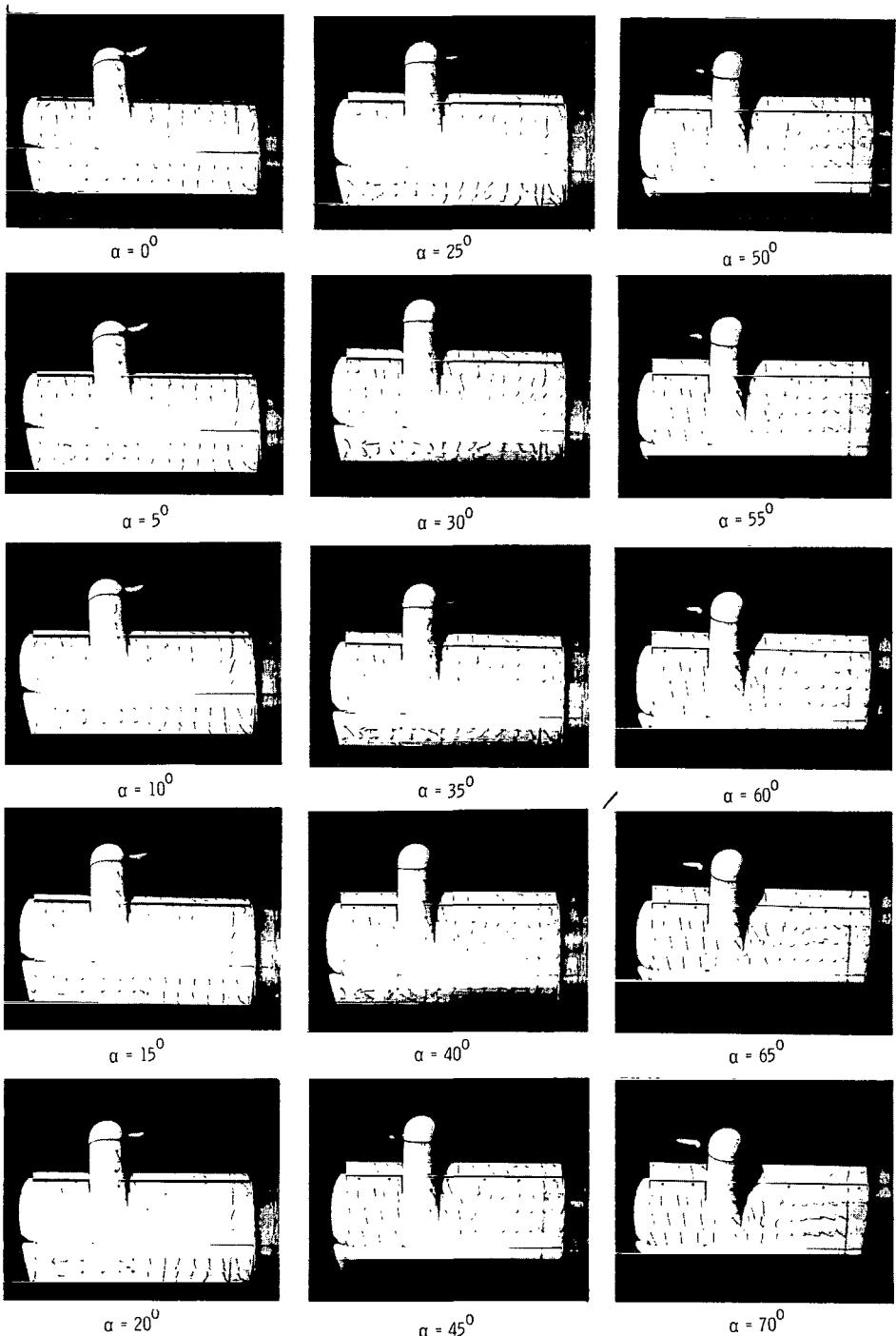
Figure 12.- Aerodynamic and flow characteristics of the model with the full-span leading-edge slat deflected 20° and the trailing-edge flap deflected. $\delta_f = 40^\circ$.



(b) Flow characteristics; $C_{T,s} = 1.00$.

L-64-4457

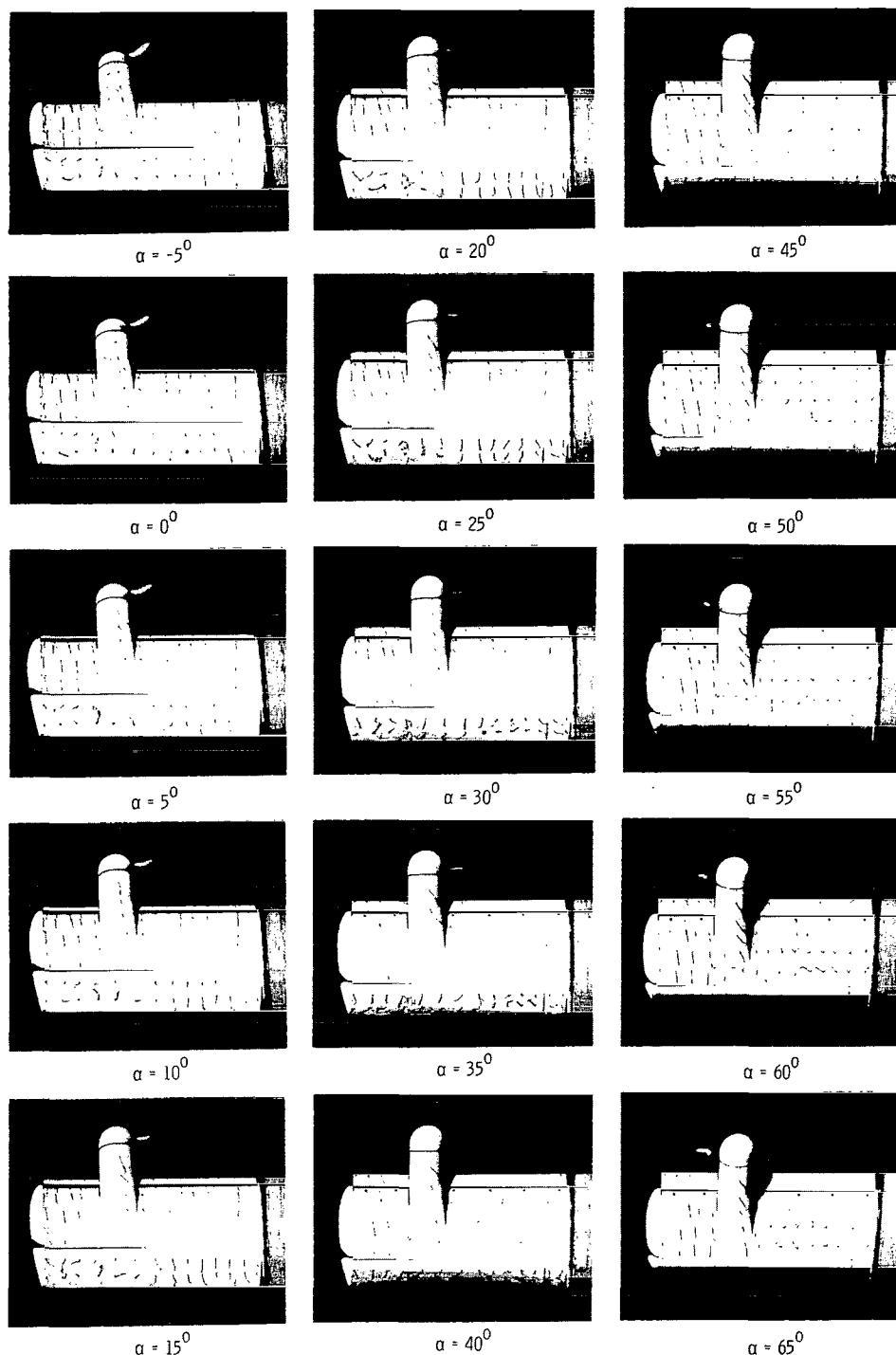
Figure 12.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4458

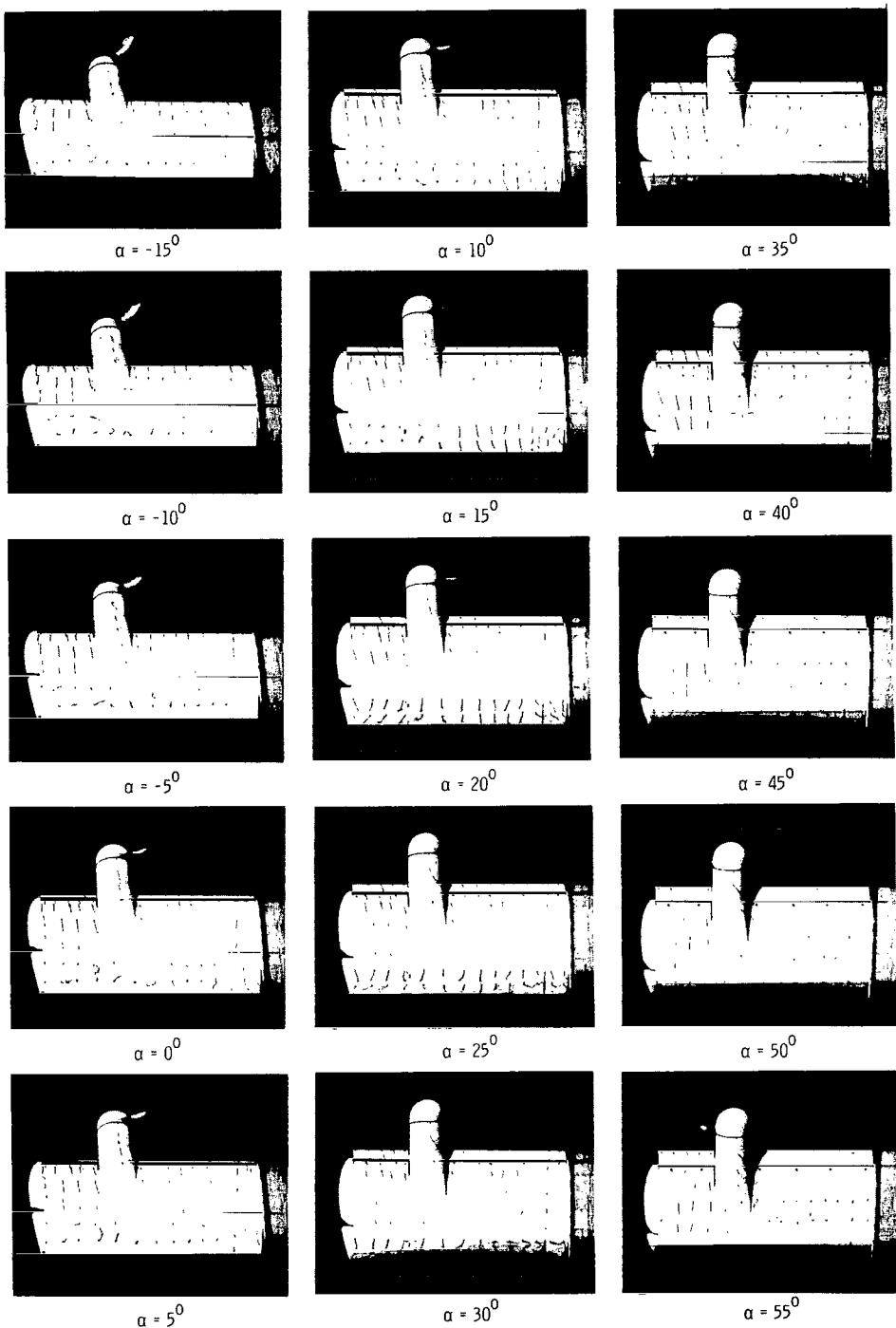
Figure 12.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4459

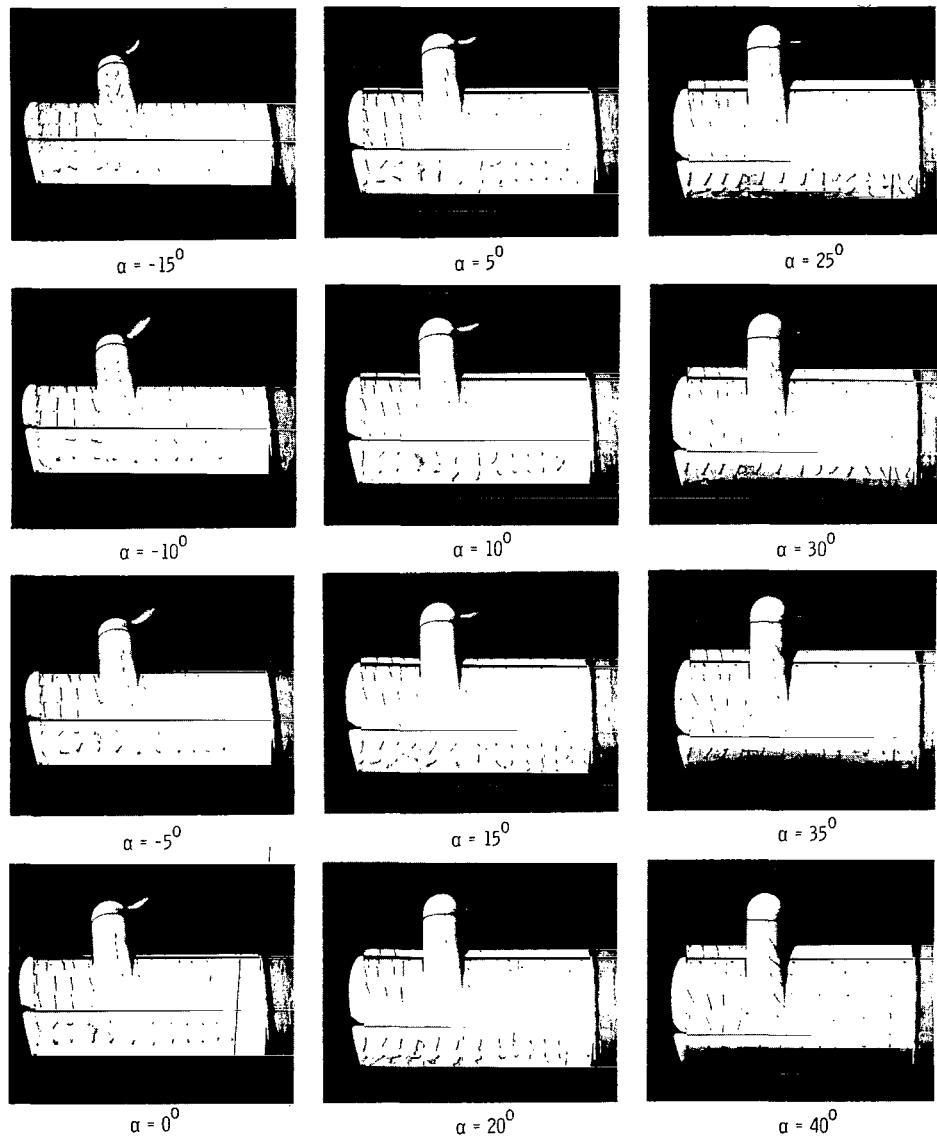
Figure 12.- Continued.



(e) Flow characteristics; $C_{T,S} = 0.80.$

L-64-4460

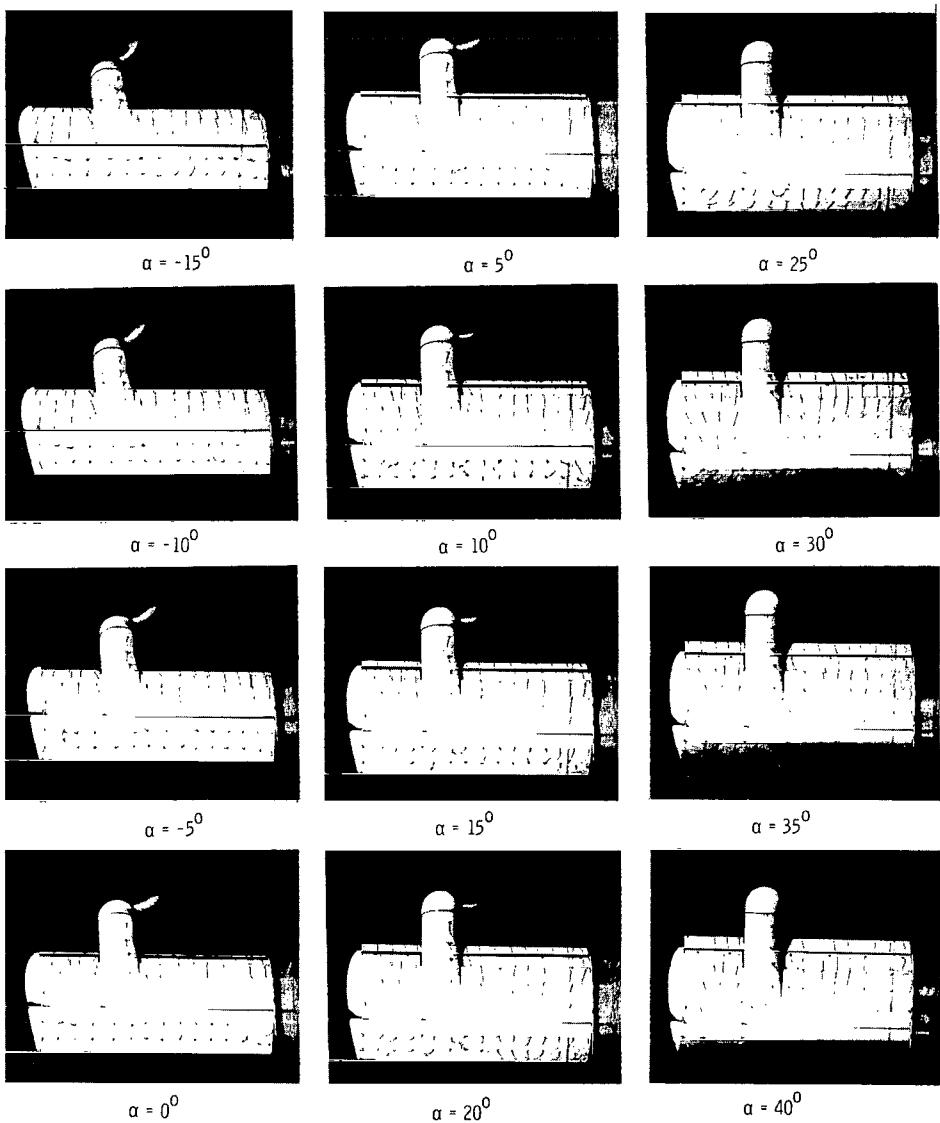
Figure 12.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60$.

L-64-4461

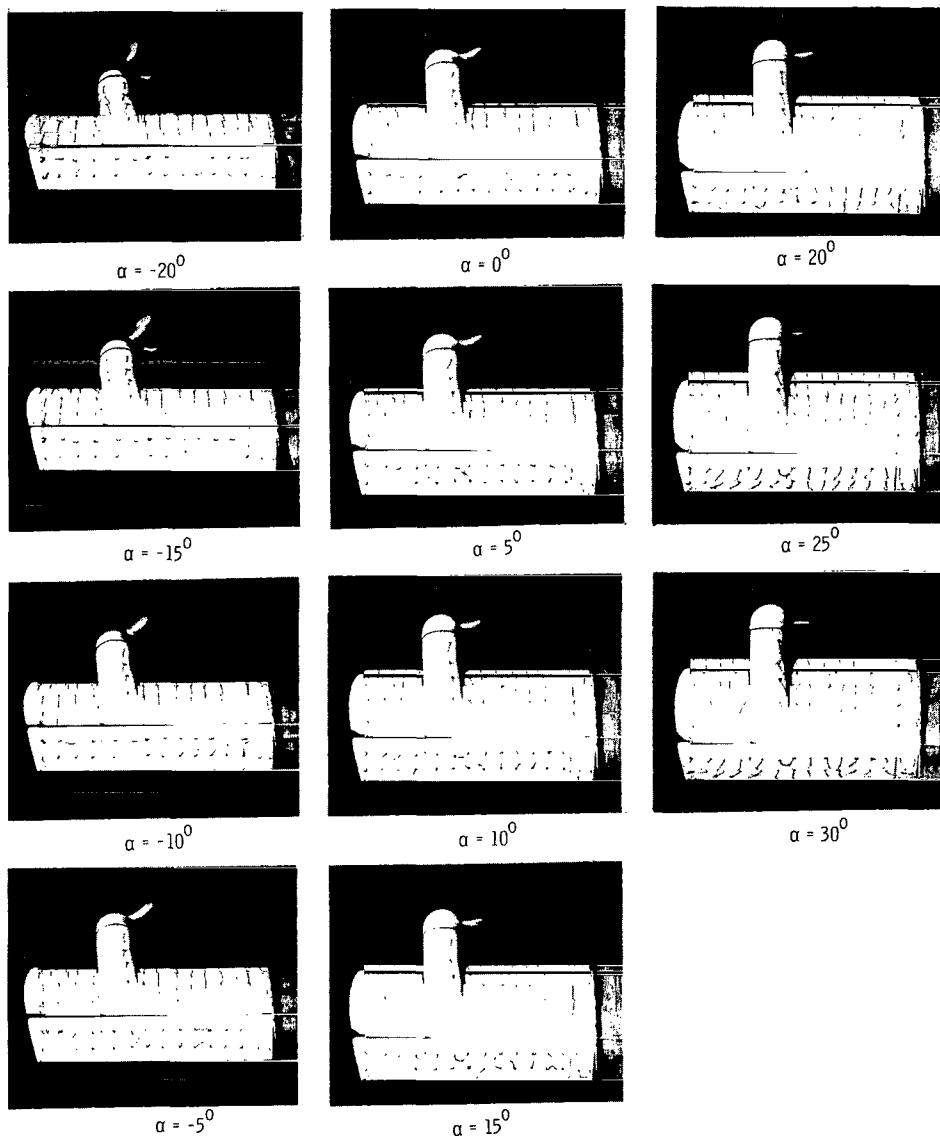
Figure 12.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30$.

L-64-4462

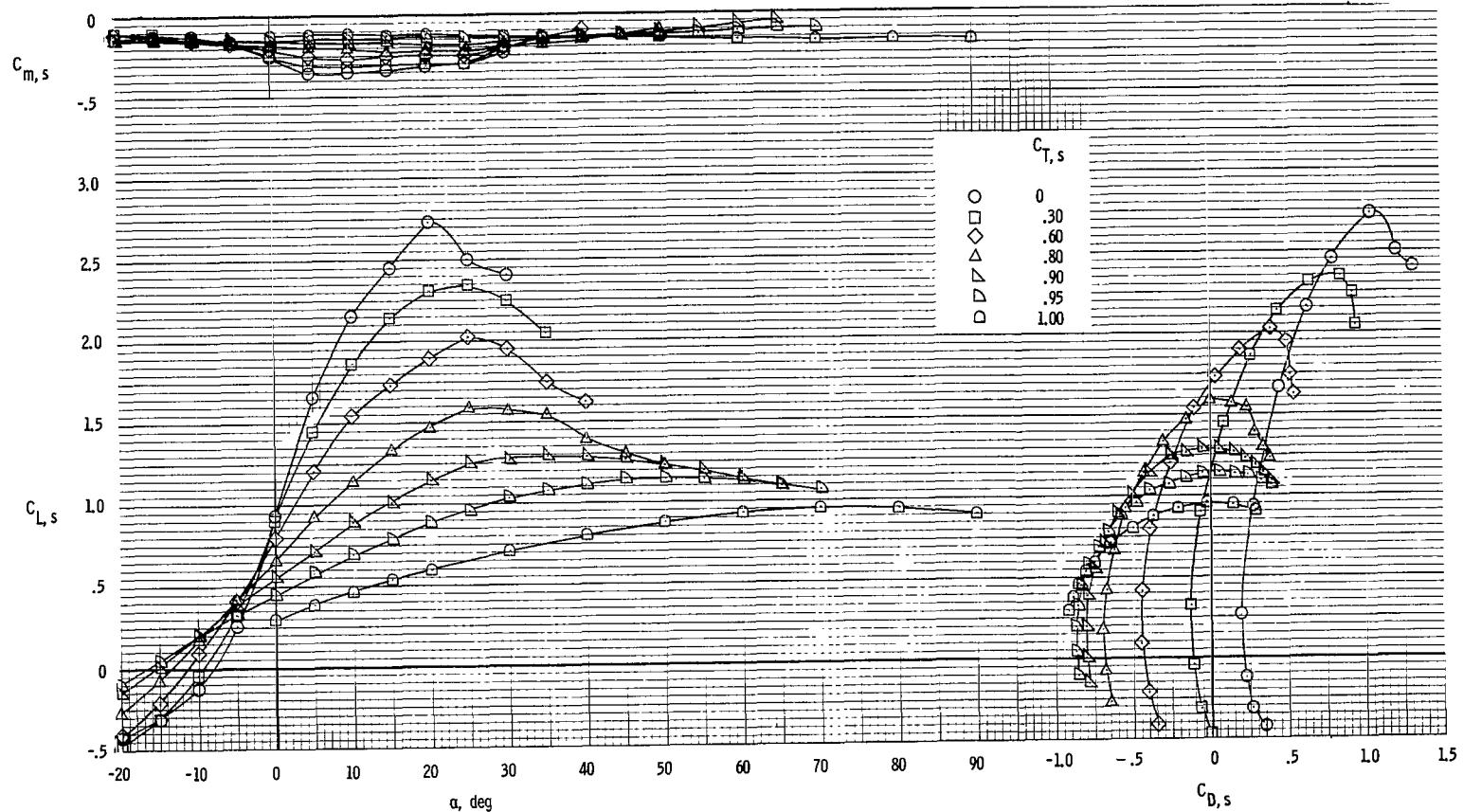
Figure 12.- Continued.



(h) Flow characteristics; $C_{T,s} = 0.$

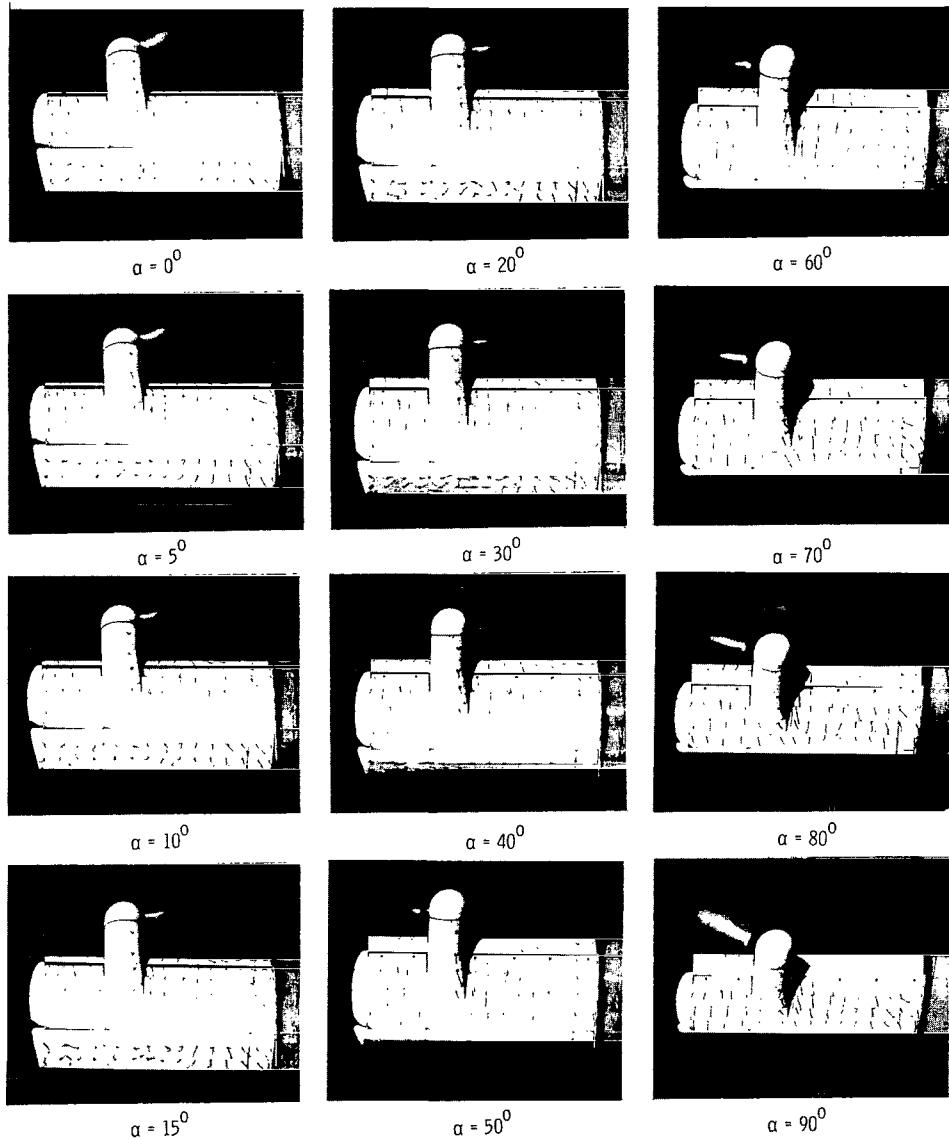
L-64-4463

Figure 12.- Concluded.



(a) Aerodynamic characteristics.

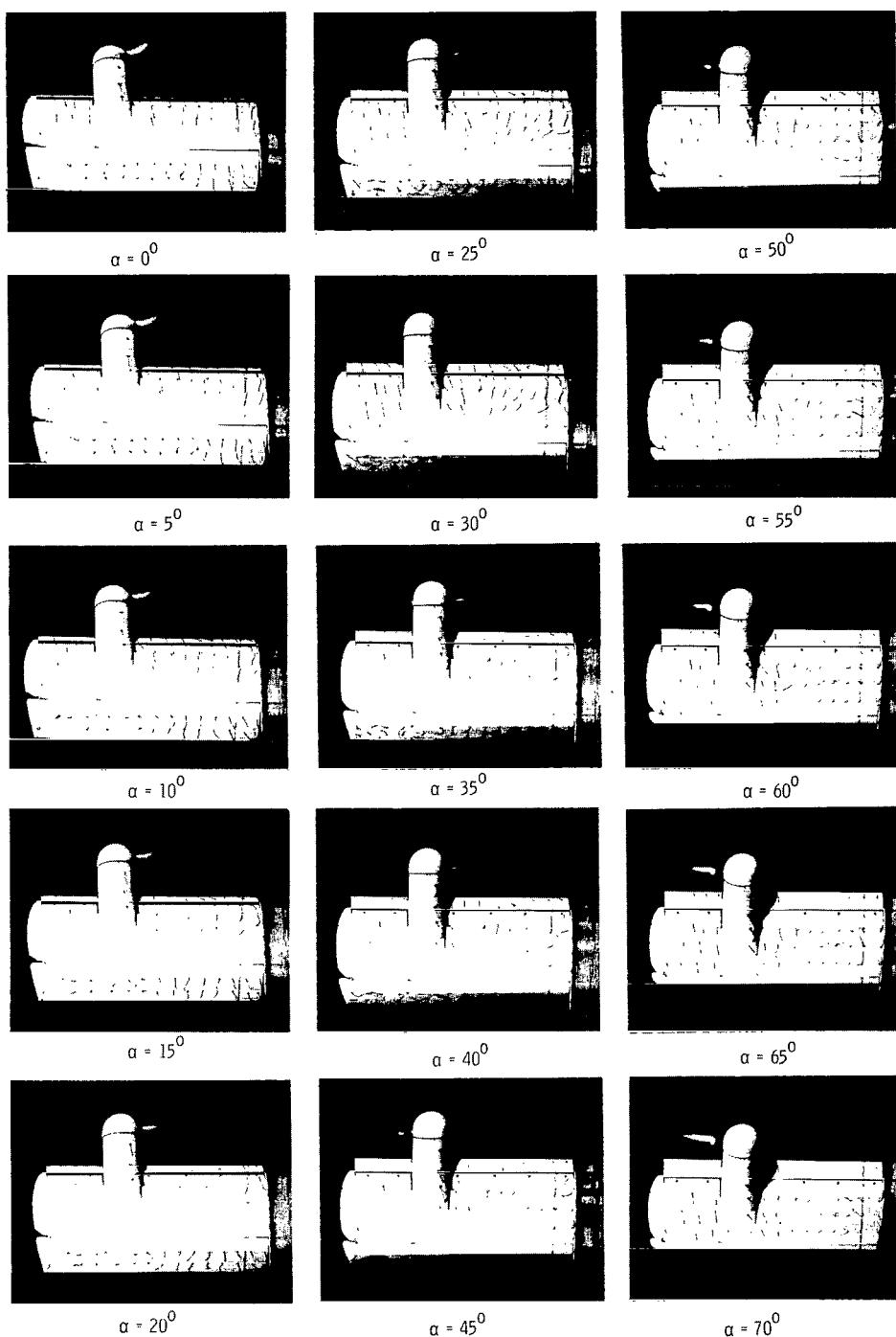
Figure 13.- Aerodynamic and flow characteristics of the model with the full-span leading-edge slat deflected 20° and the trailing-edge flap deflected. $\delta_f = 50^\circ$.



(b) Flow characteristics; $C_{T,s} = 1.00$.

L-64-4464

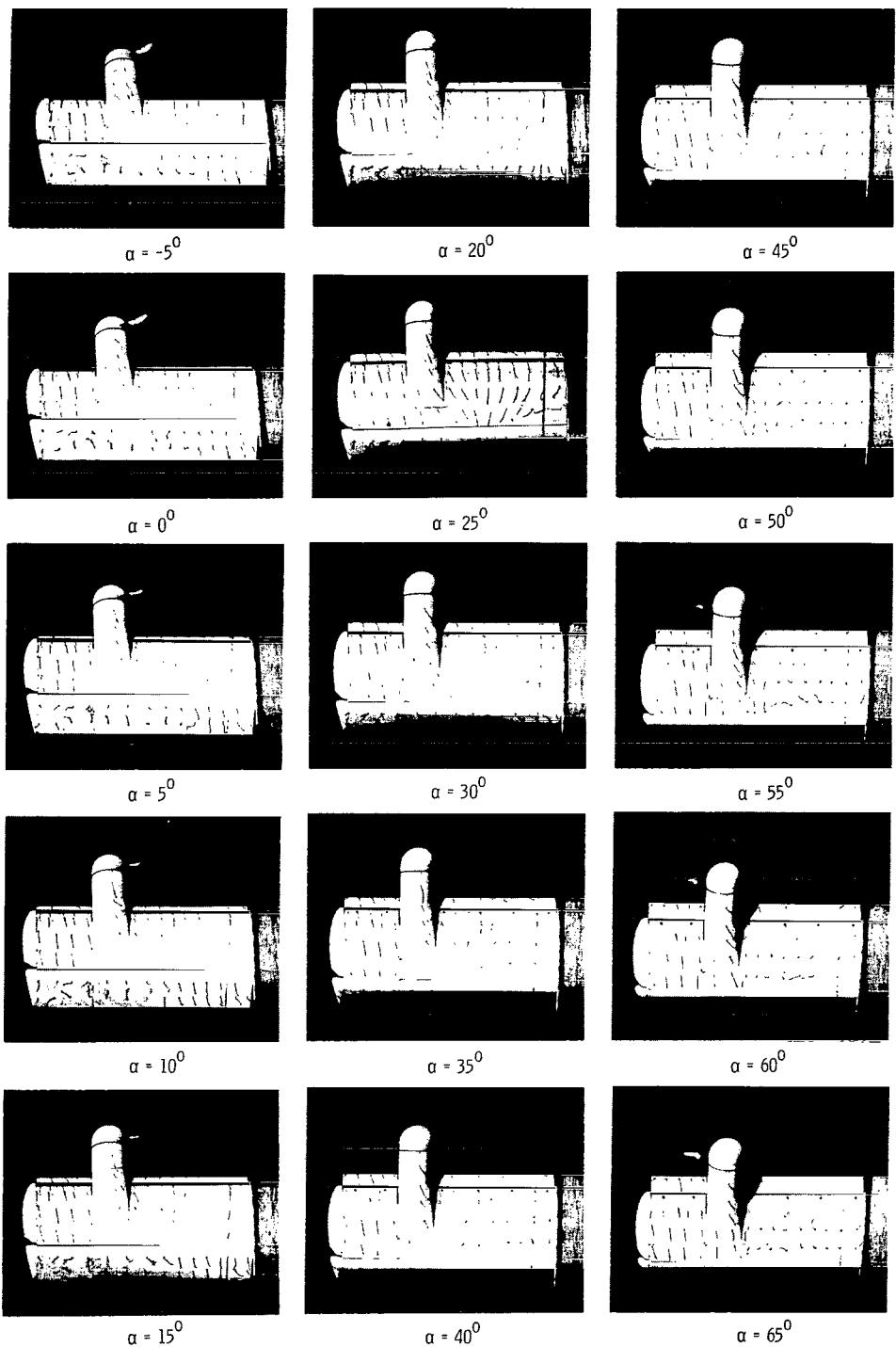
Figure 13.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4465

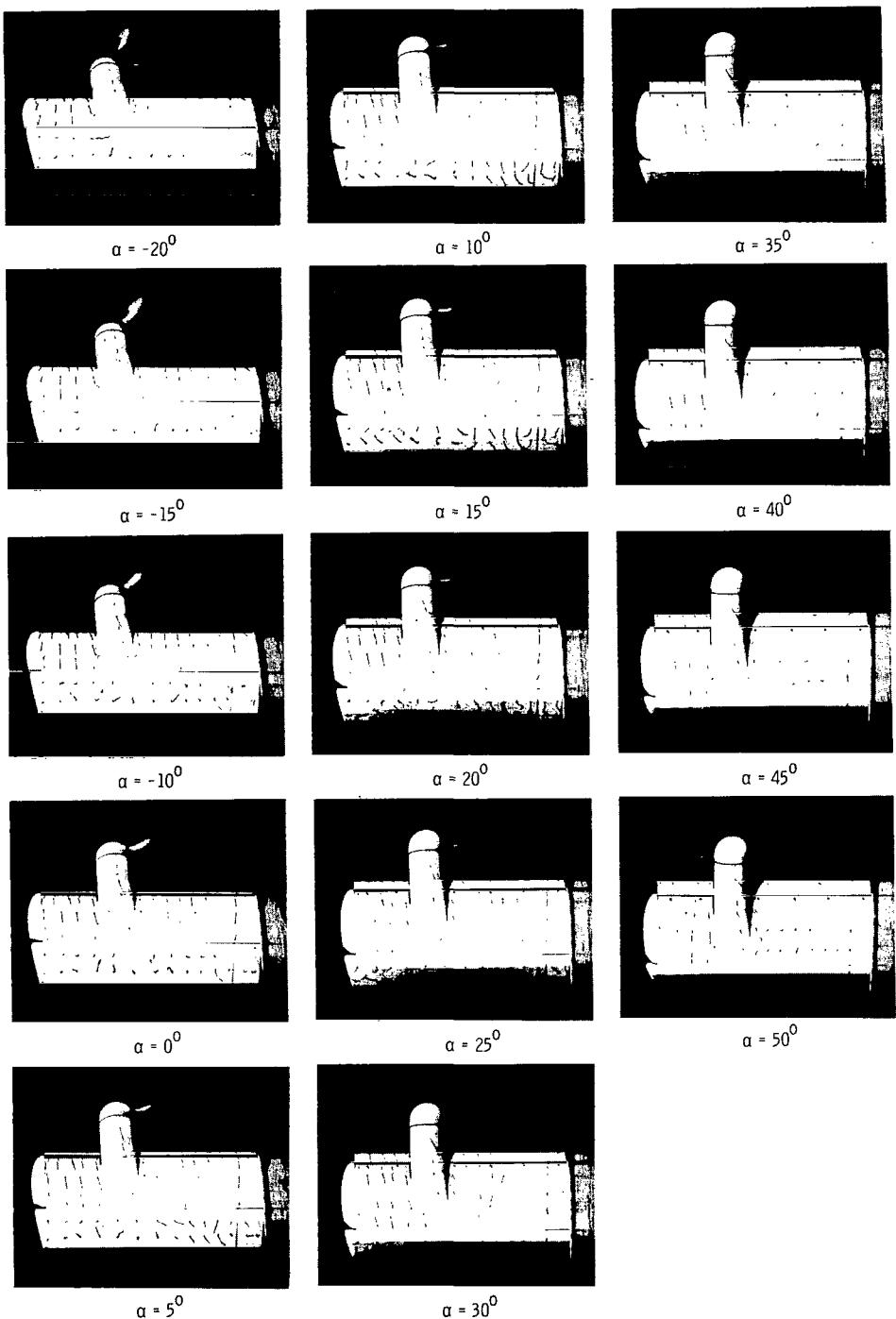
Figure 13.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90.$

L-64-4466

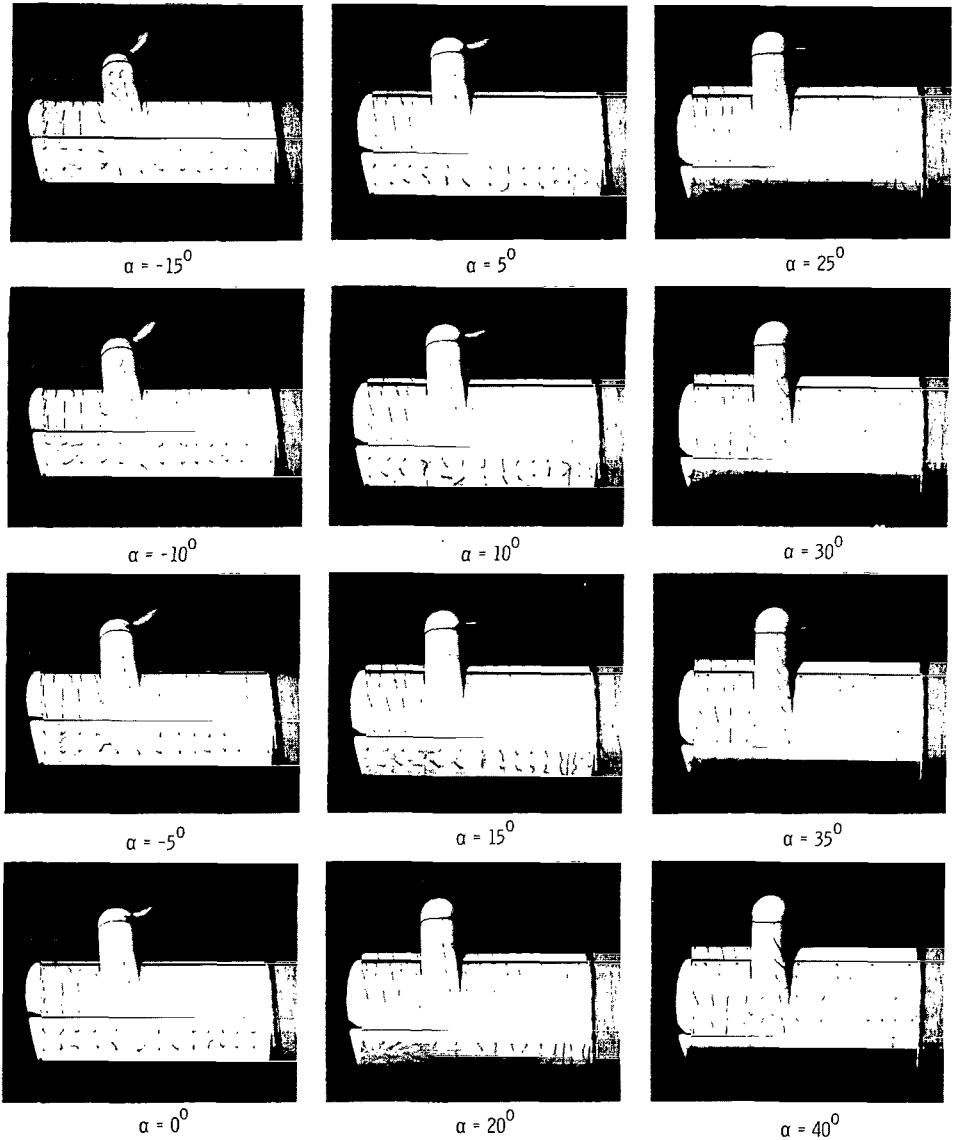
Figure 13.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4467

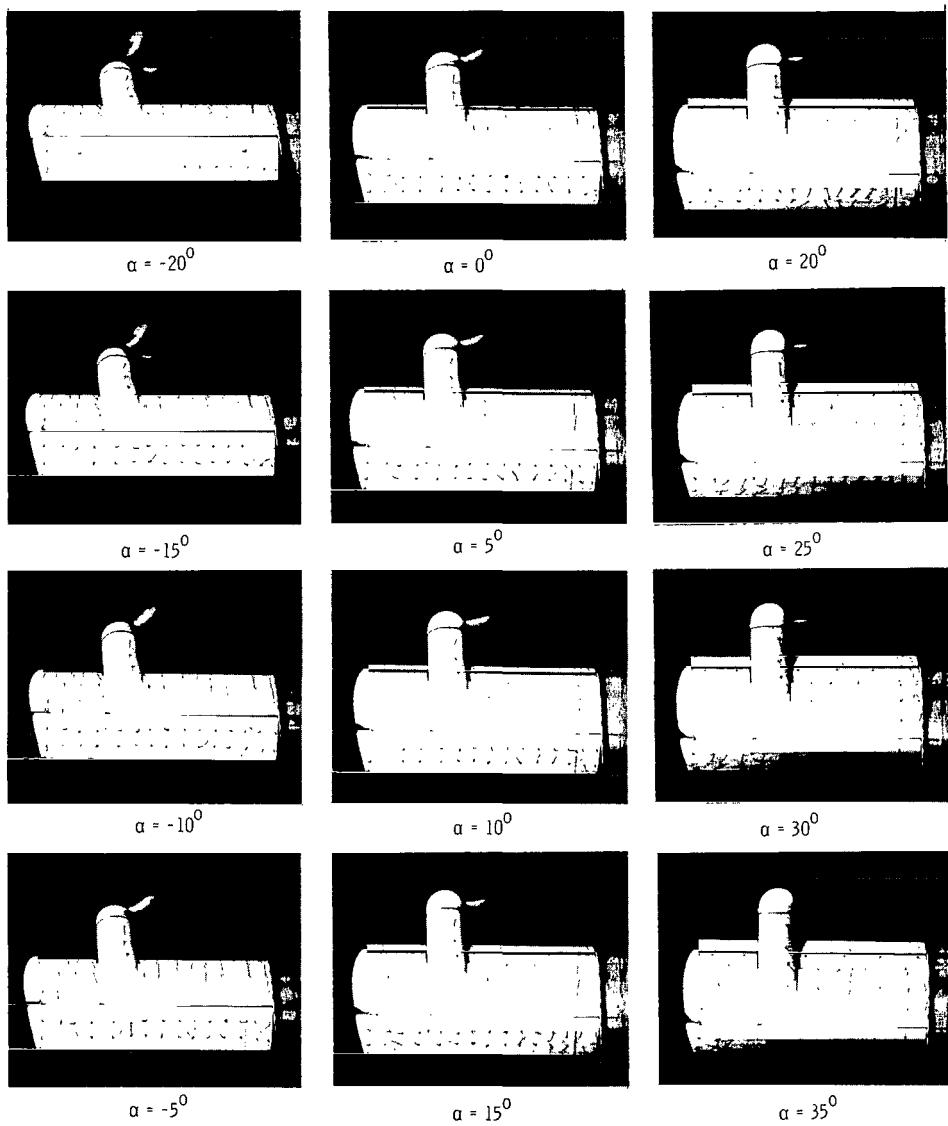
Figure 13.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60.$

L-64-4468

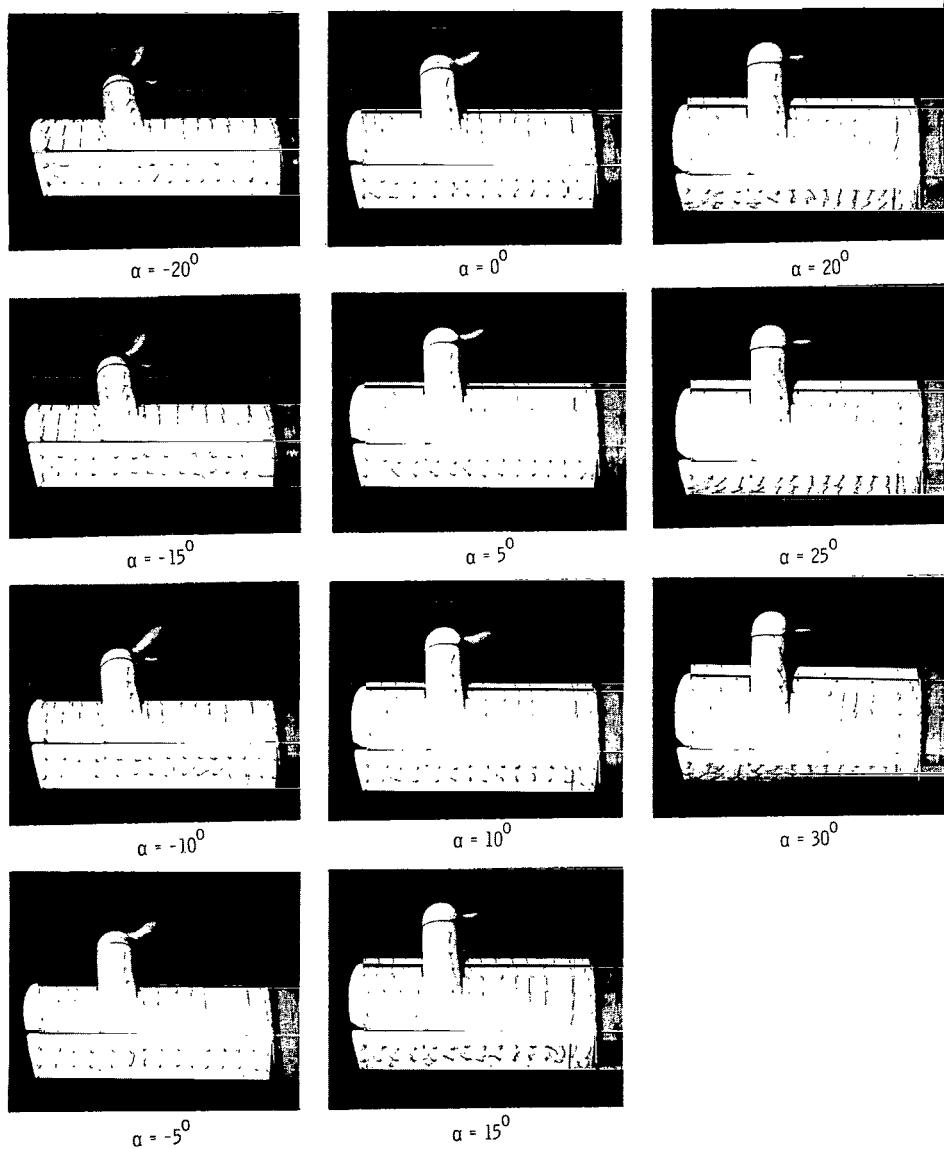
Figure 13.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30$.

L-64-4469

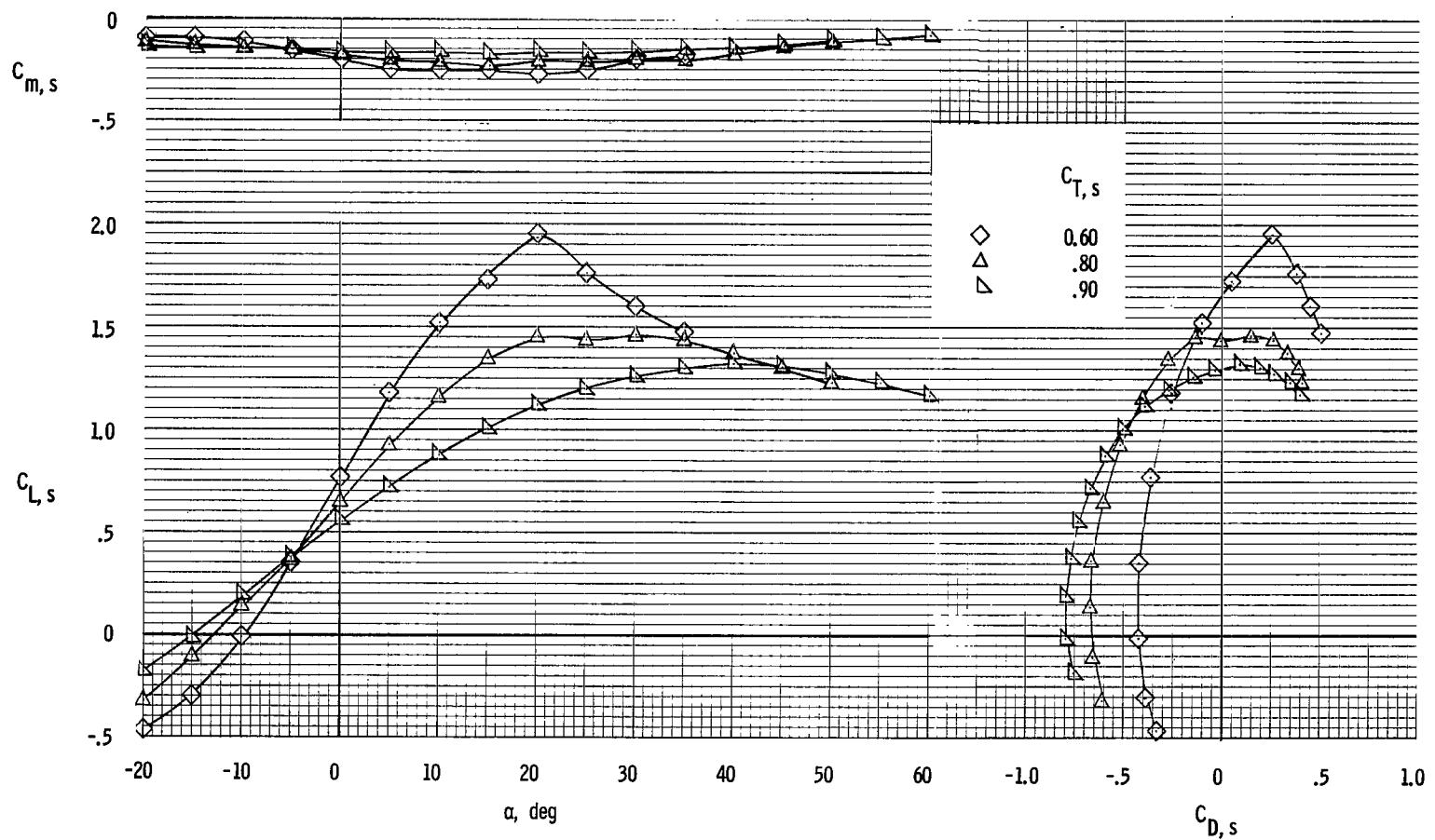
Figure 13.- Continued.



(h) Flow characteristics; $C_{T,s} = 0$.

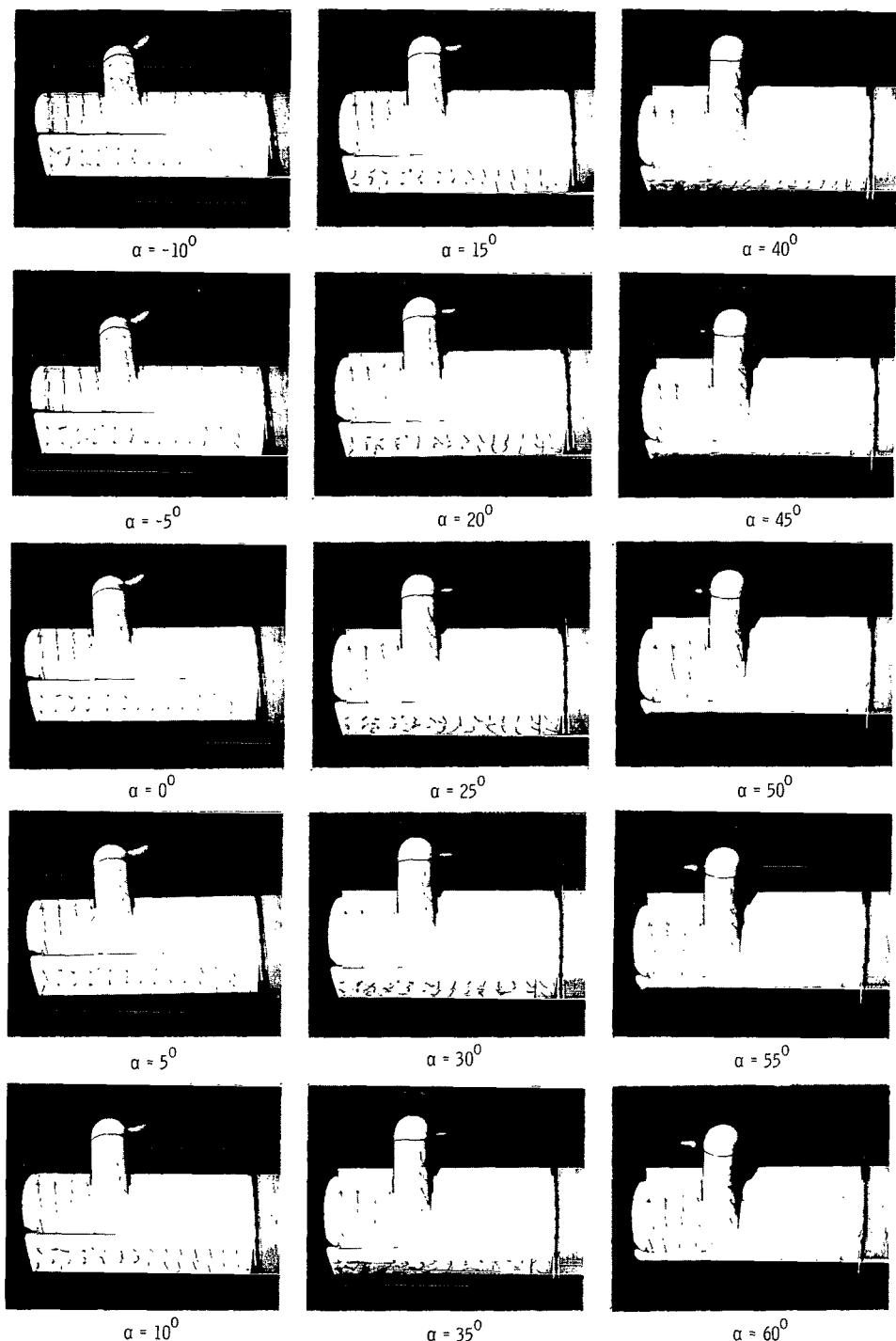
L-64-4470

Figure 13.- Concluded.



(a) Aerodynamic characteristics.

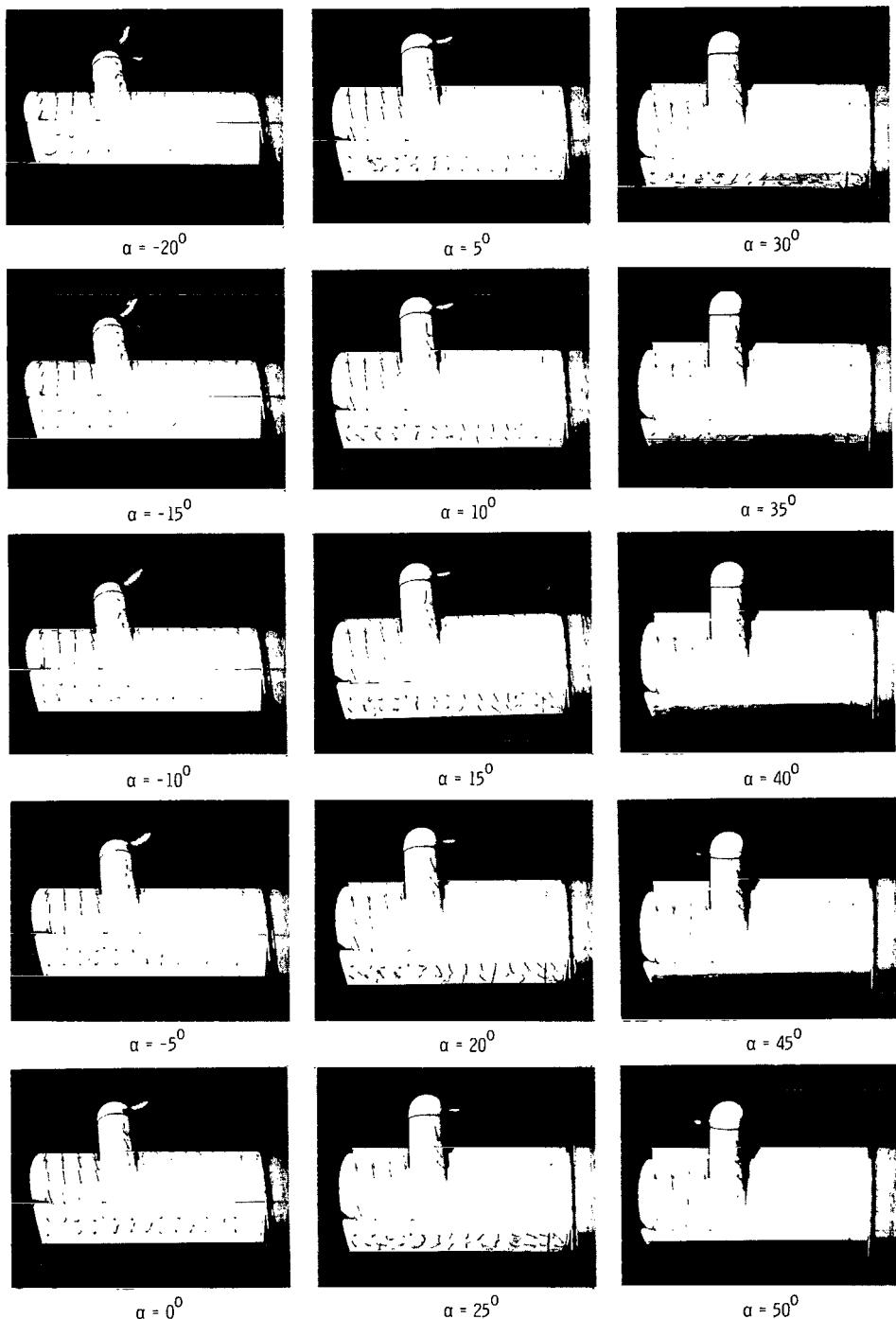
Figure 14.- Aerodynamic and flow characteristics of the model with the trailing-edge flap deflected 50° and with the full-span Krueger leading-edge flap deflected 40° .



(b) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4471

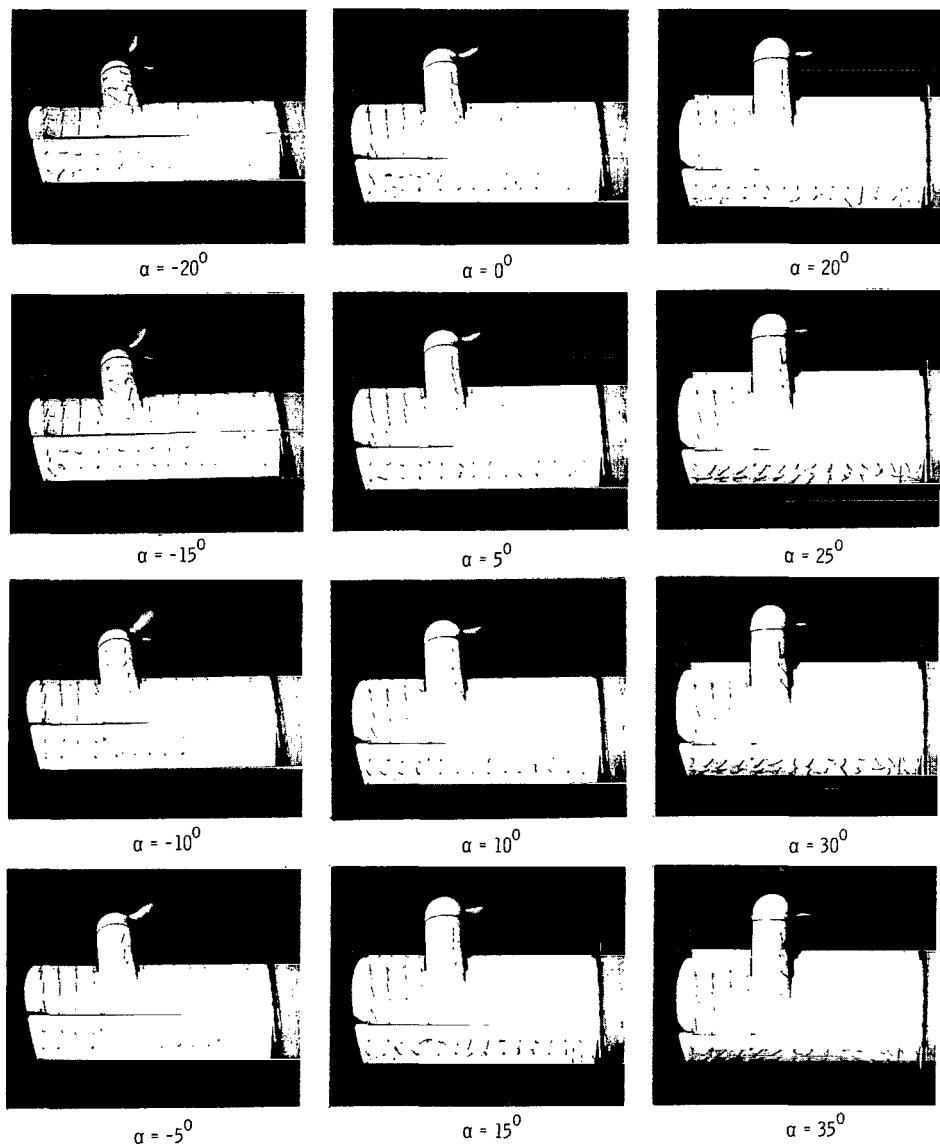
Figure 14.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4472

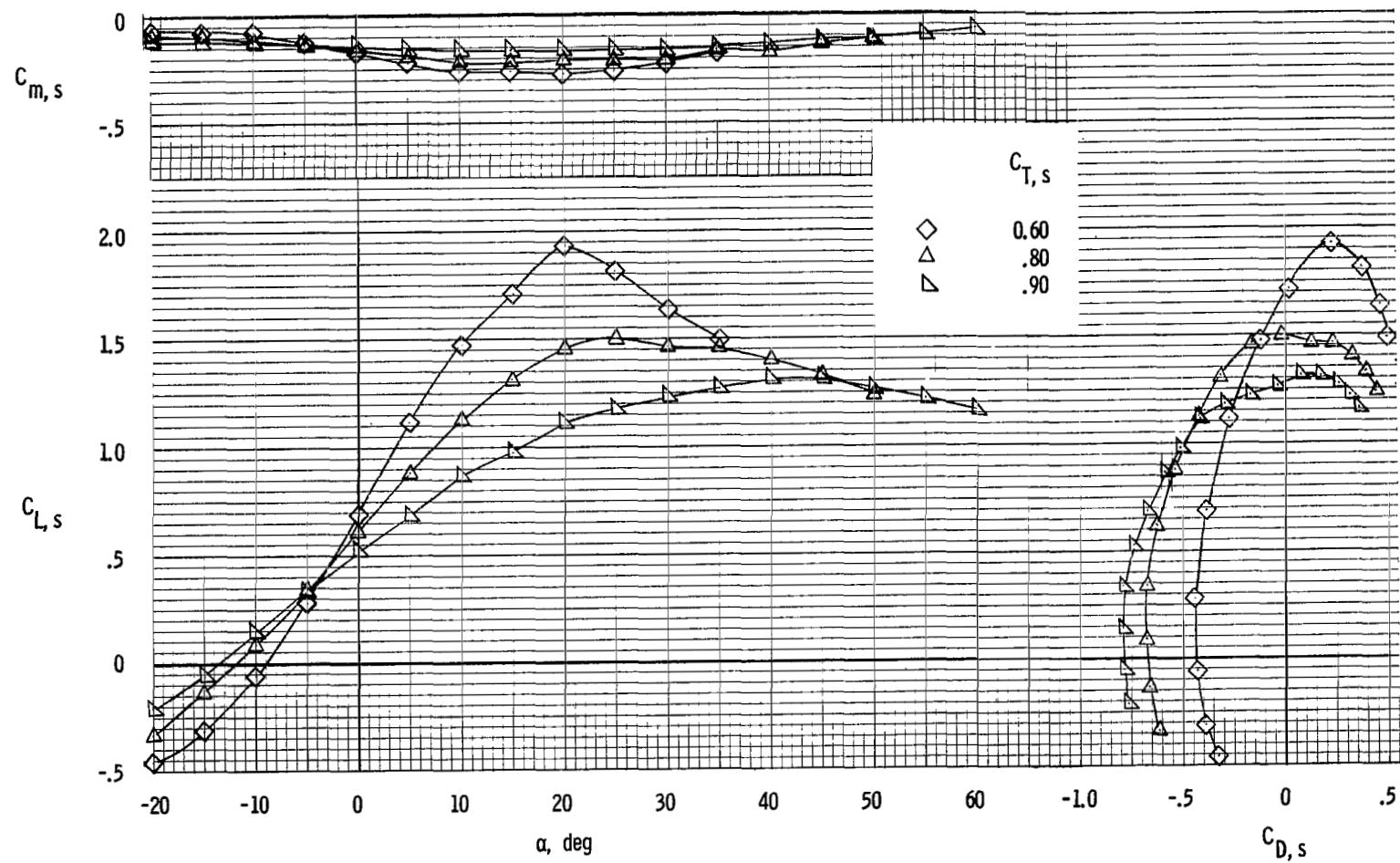
Figure 14.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.60$.

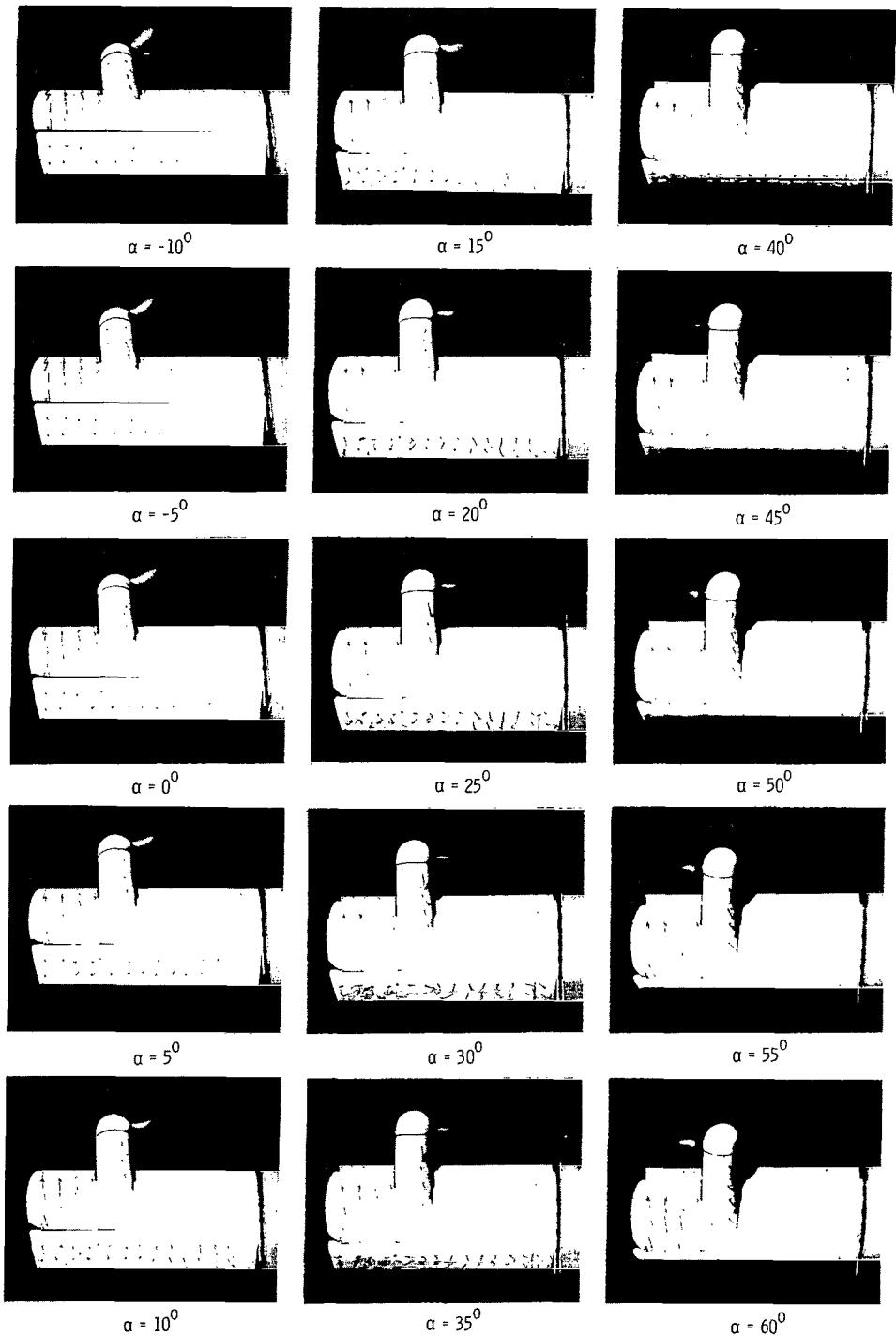
L-64-4473

Figure 14.- Concluded.



(a) Aerodynamic characteristics.

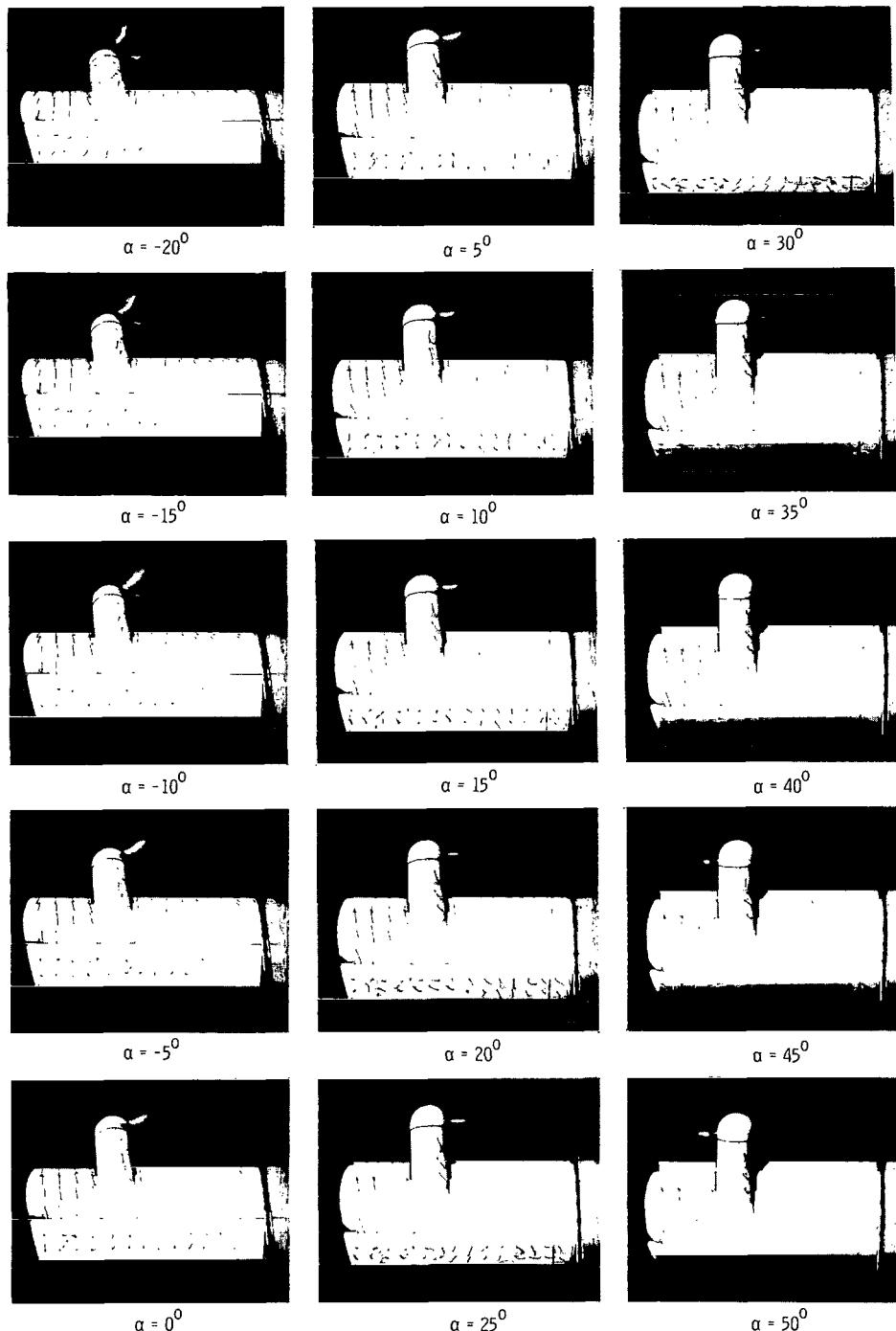
Figure 15.- Aerodynamic and flow characteristics of the model with the trailing-edge flap deflected 50° and with the full-span Krueger leading-edge flap deflected 50° .



(b) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4474

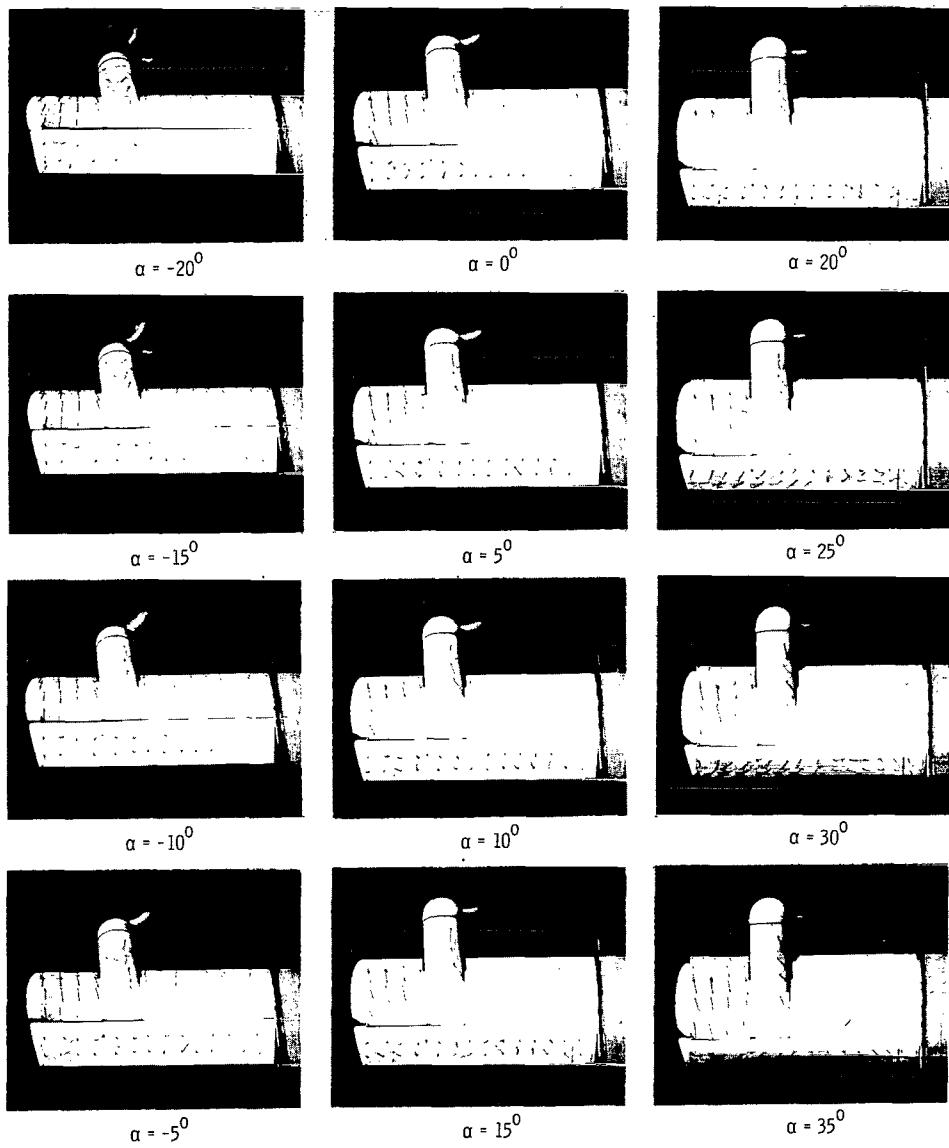
Figure 15.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.80$.

L-64-4475

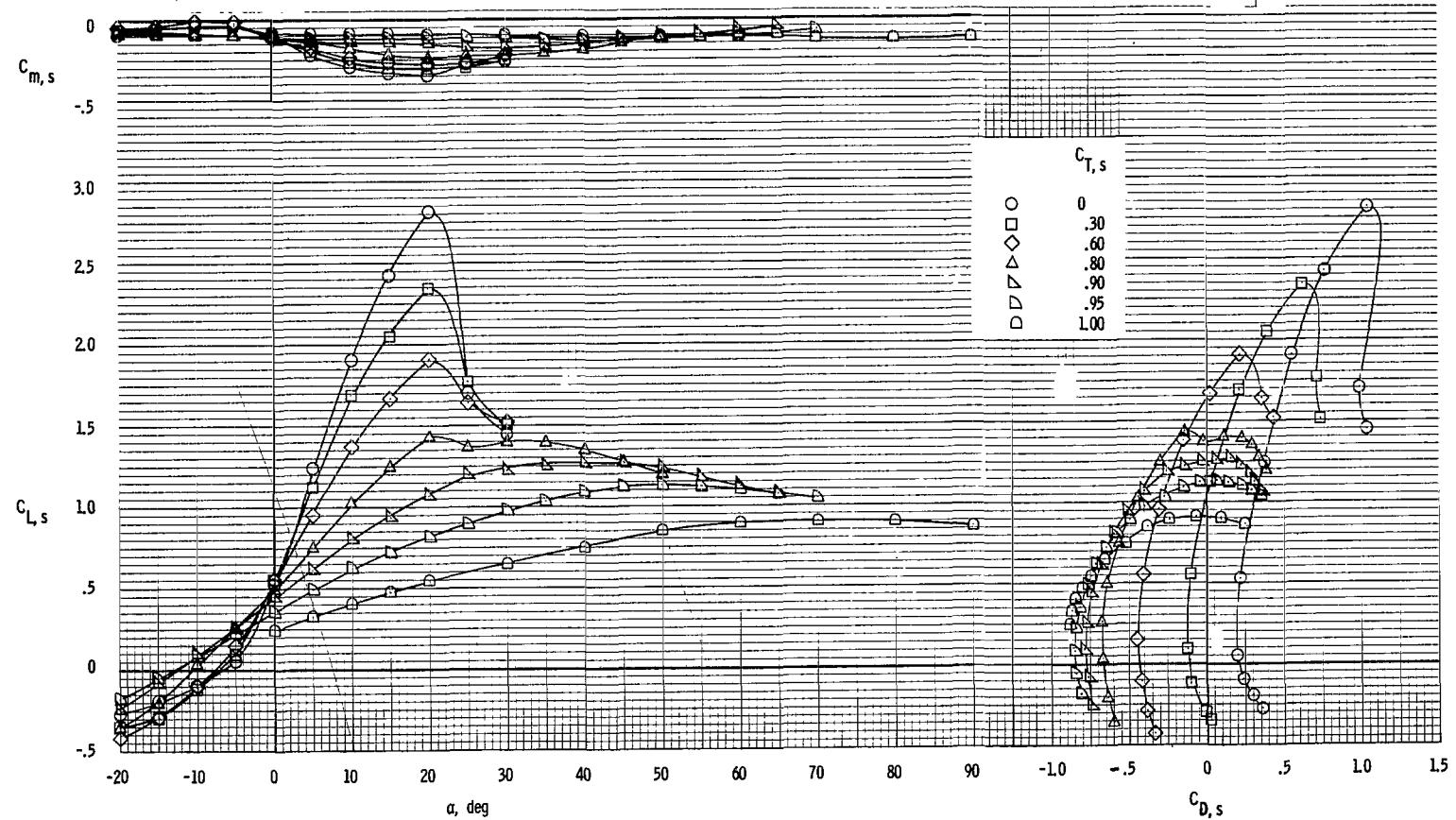
Figure 15.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.60$.

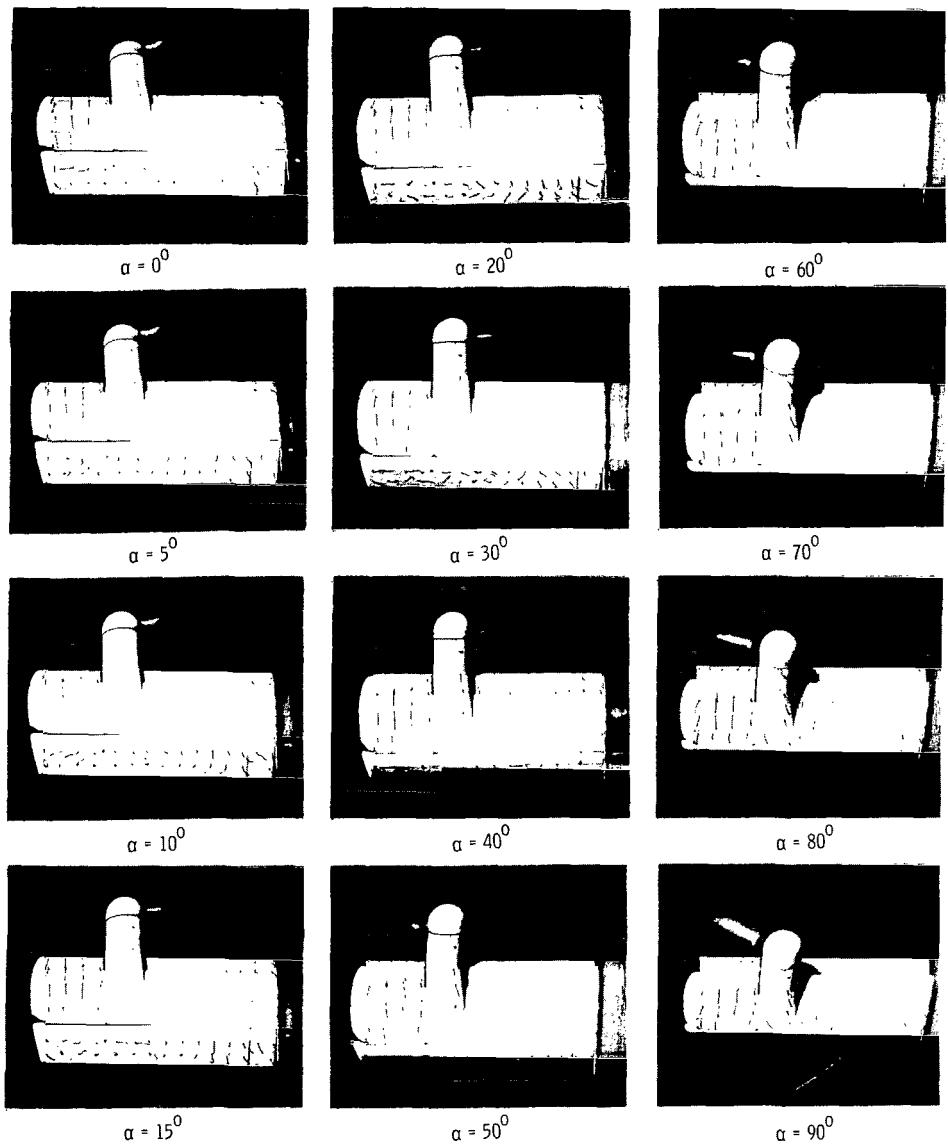
L-64-4476

Figure 15.- Concluded.



(a) Aerodynamic characteristics.

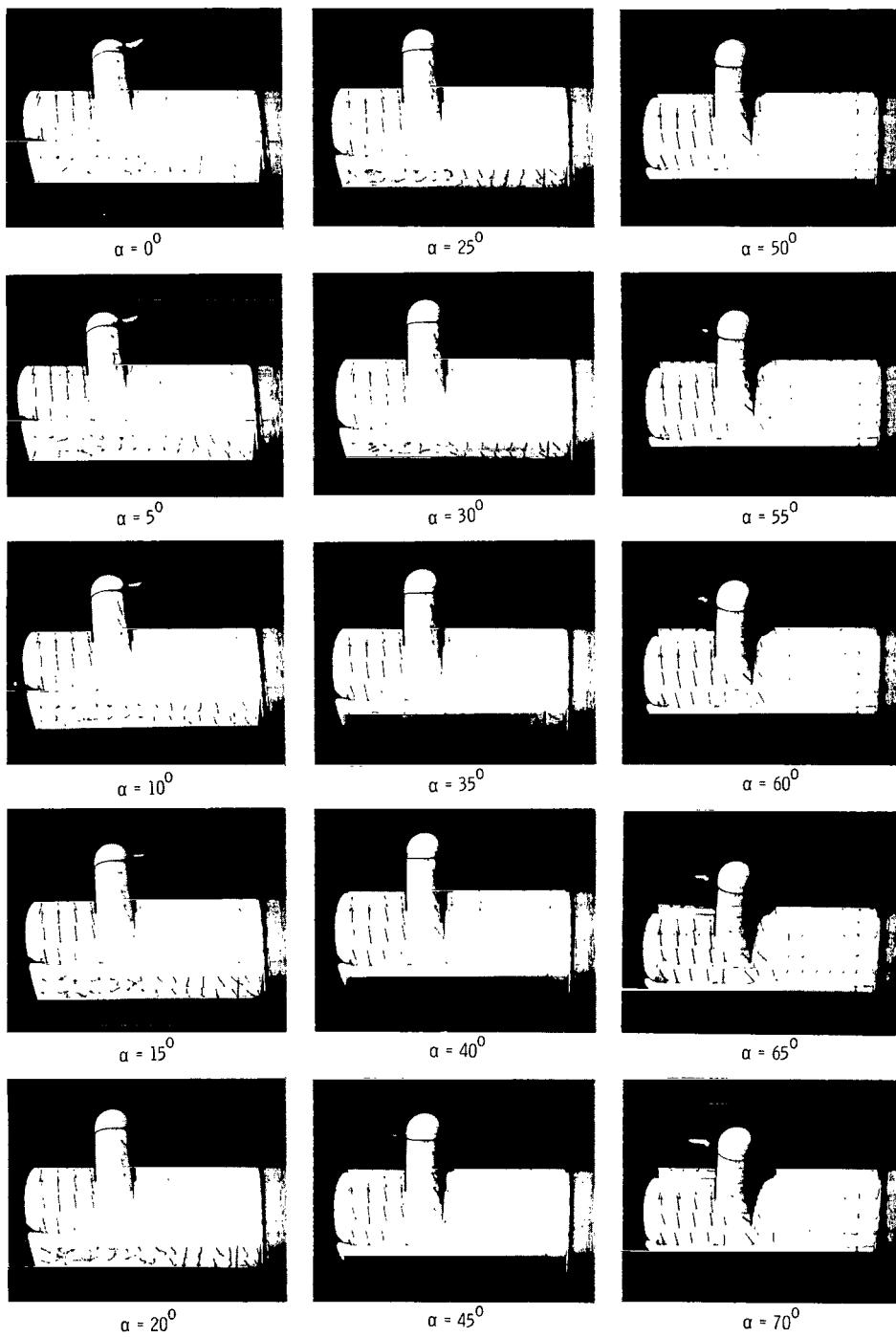
Figure 16.-- Aerodynamic and flow characteristics of the model with the trailing-edge flap deflected 50° and with the flap-span Krueger leading-edge flap deflected 70° .



(b) Flow characteristics; $C_{T,s} = 1.00$.

L-64-4477

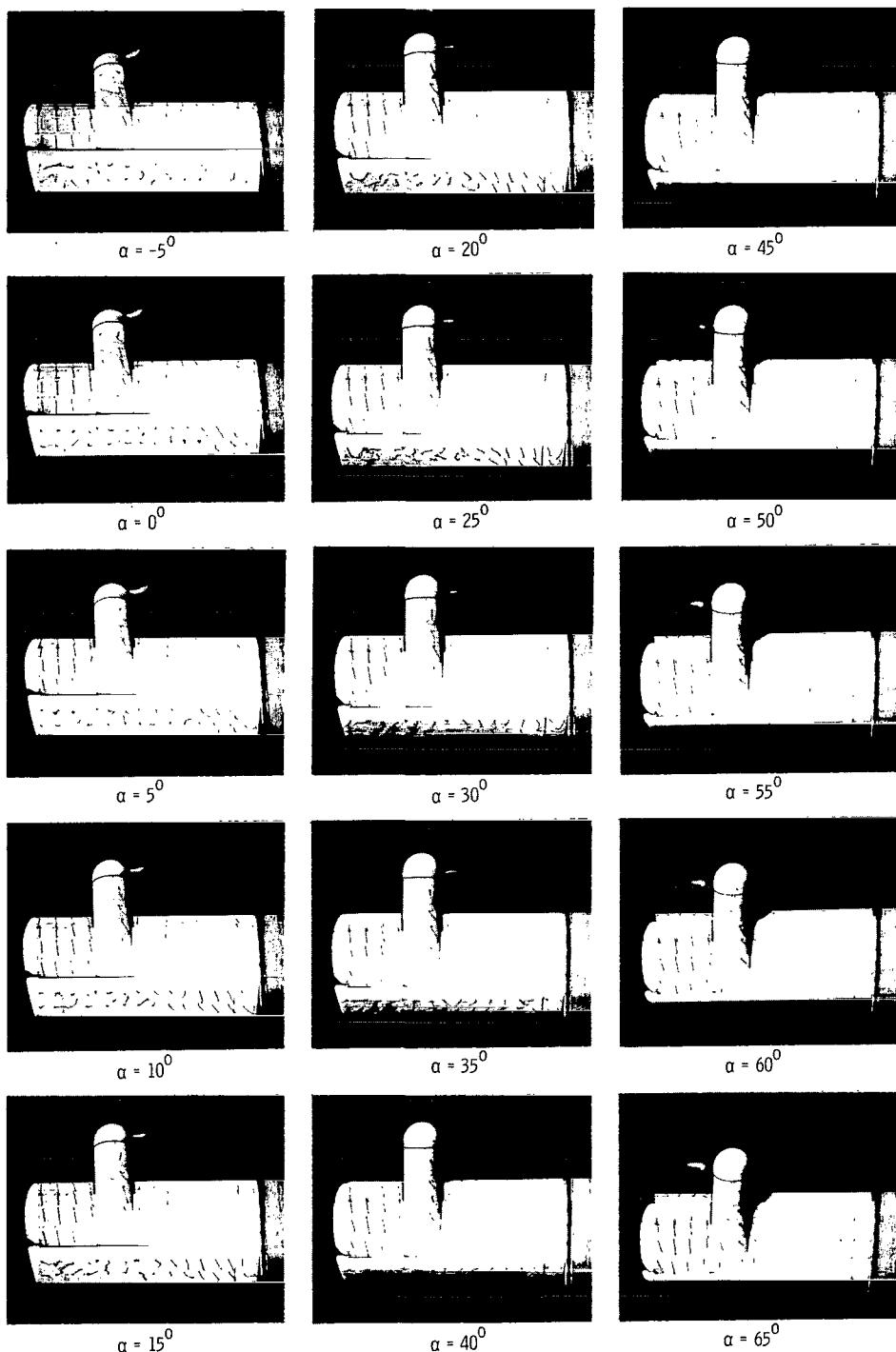
Figure 16.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4478

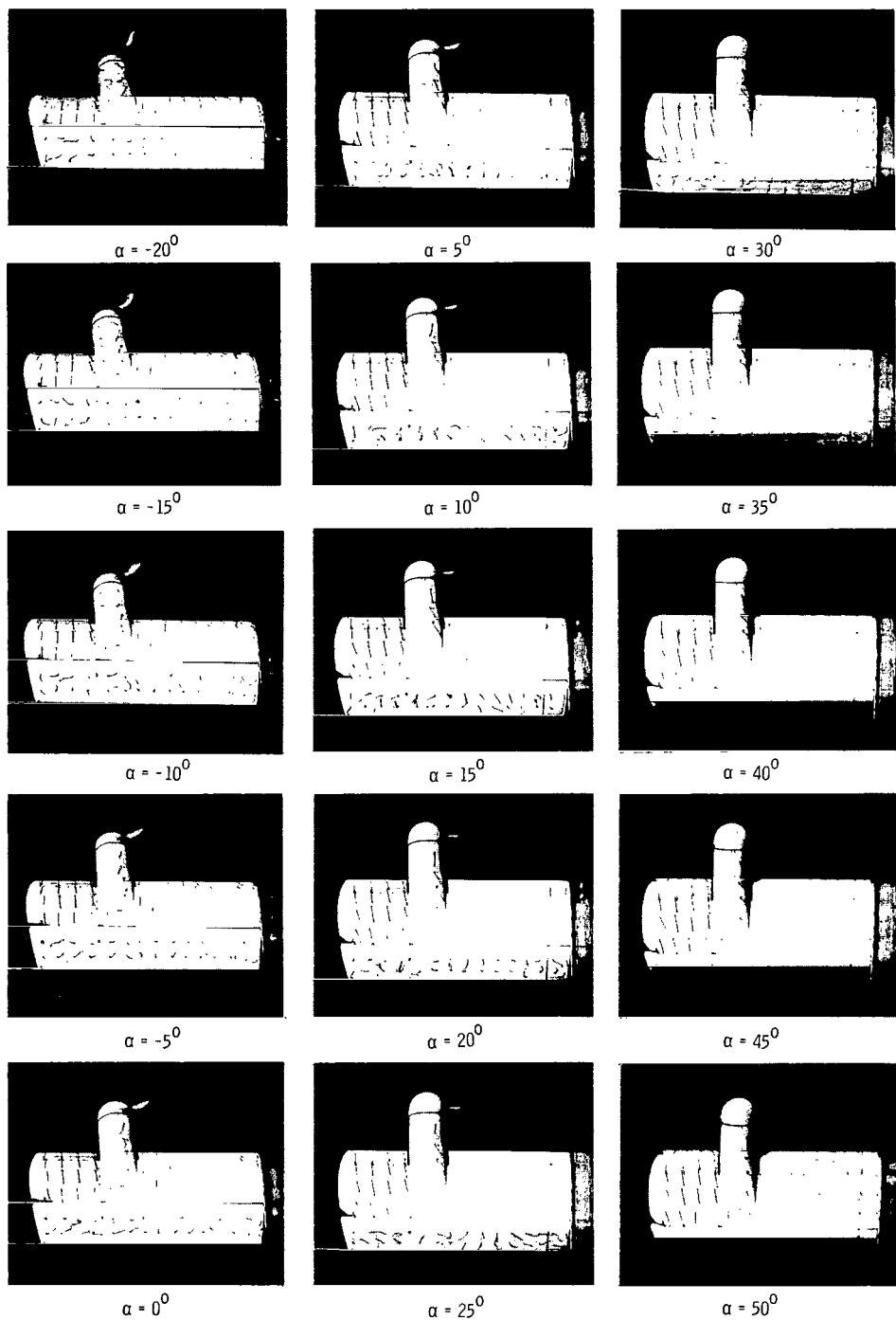
Figure 16.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90.$

L-64-4479

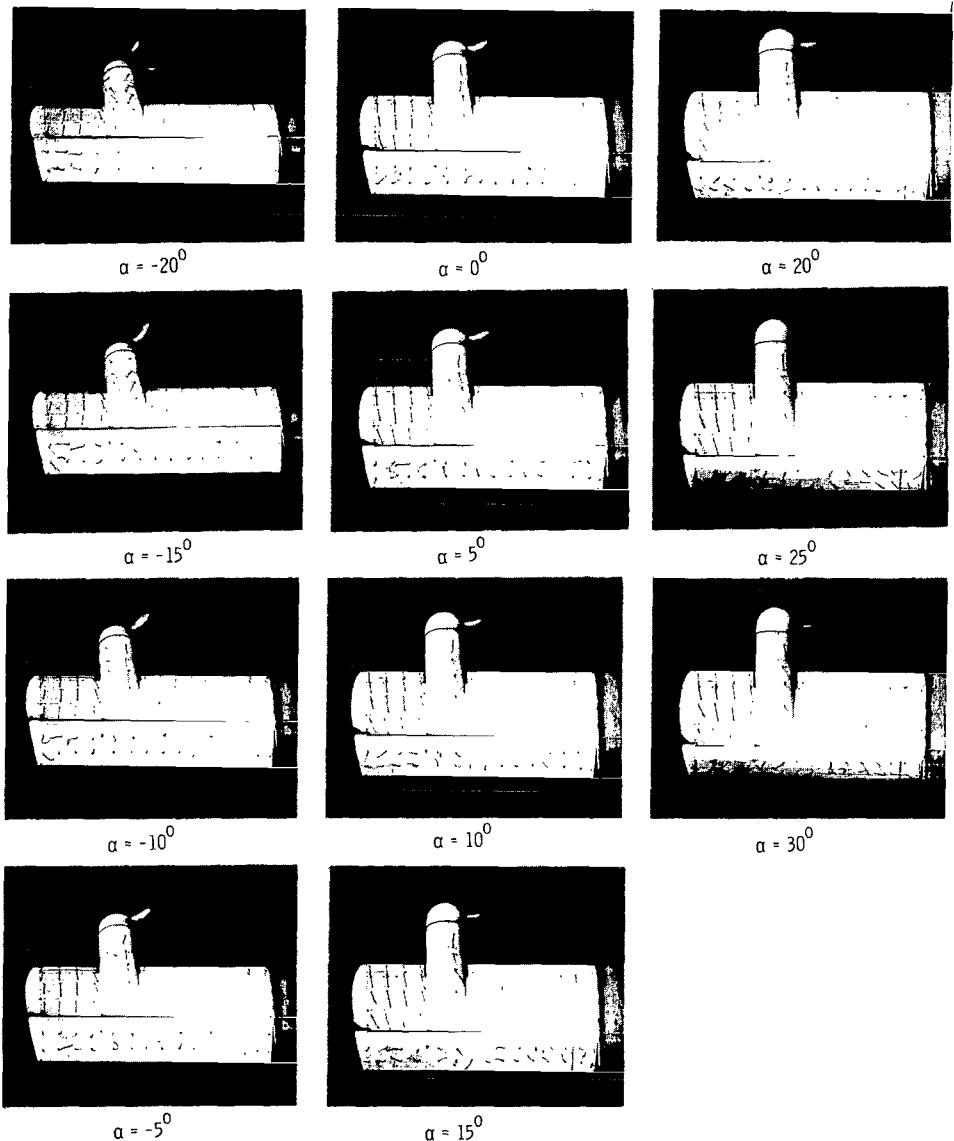
Figure 16.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4480

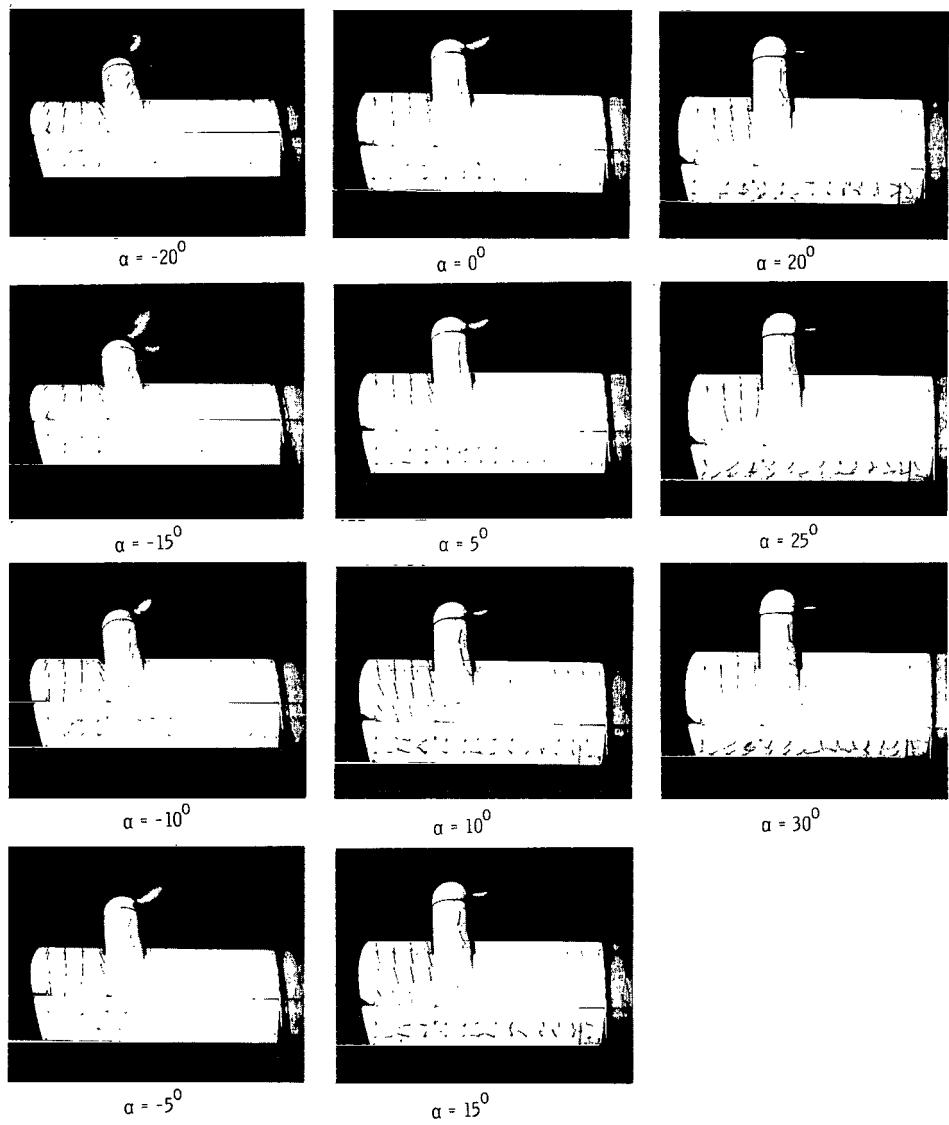
Figure 16.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60$.

L-64-4481

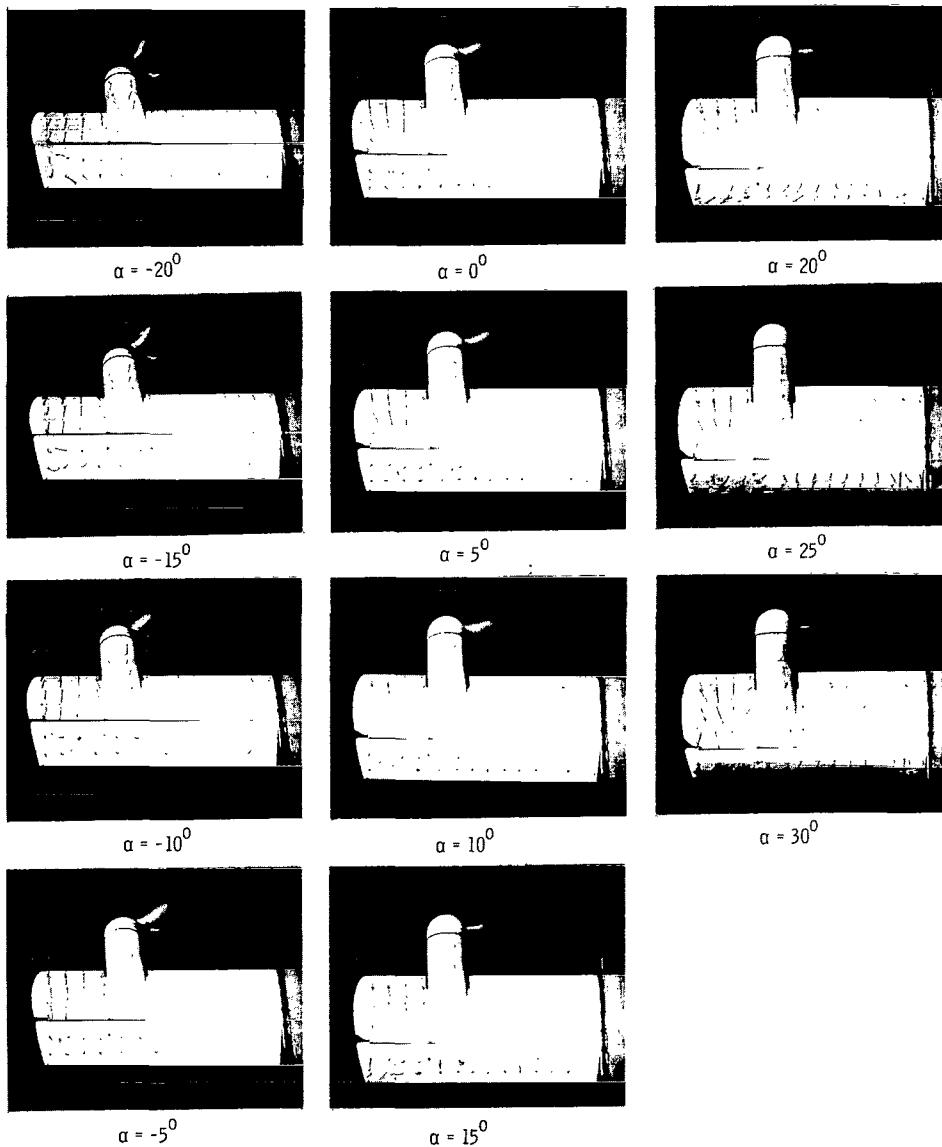
Figure 16.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30$.

L-64-4482

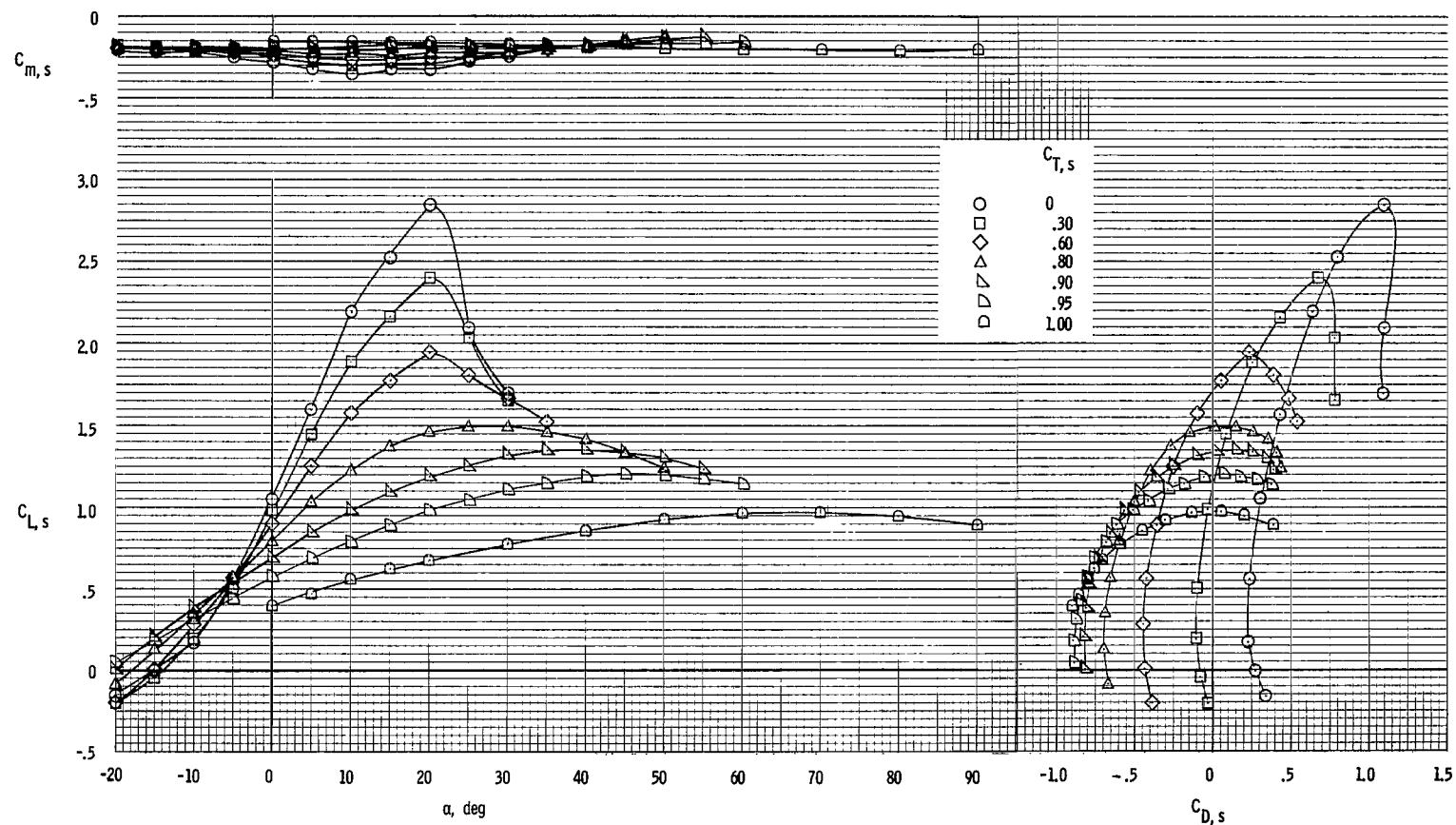
Figure 16.- Continued.



(h) Flow characteristics; $C_{T,s} = 0.$

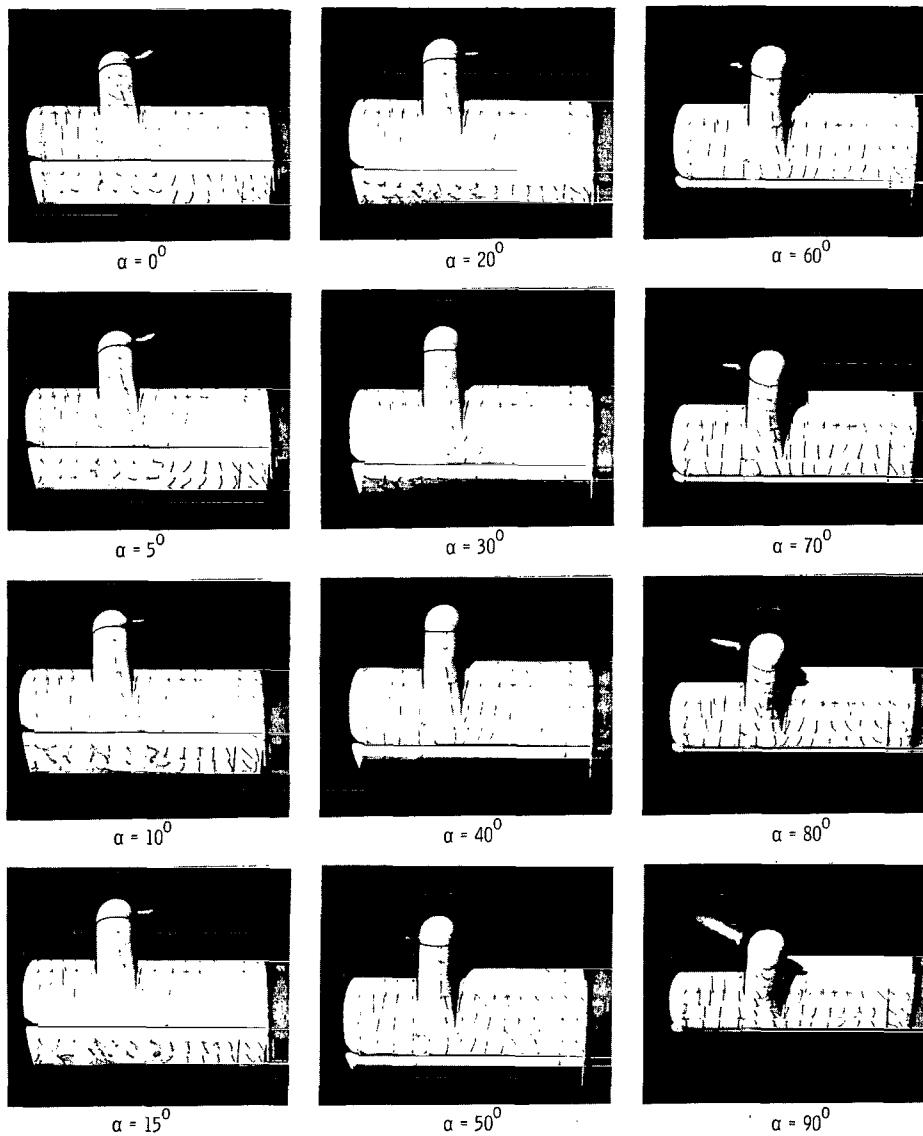
L-64-4483

Figure 16.- Concluded.



(a) Aerodynamic characteristics.

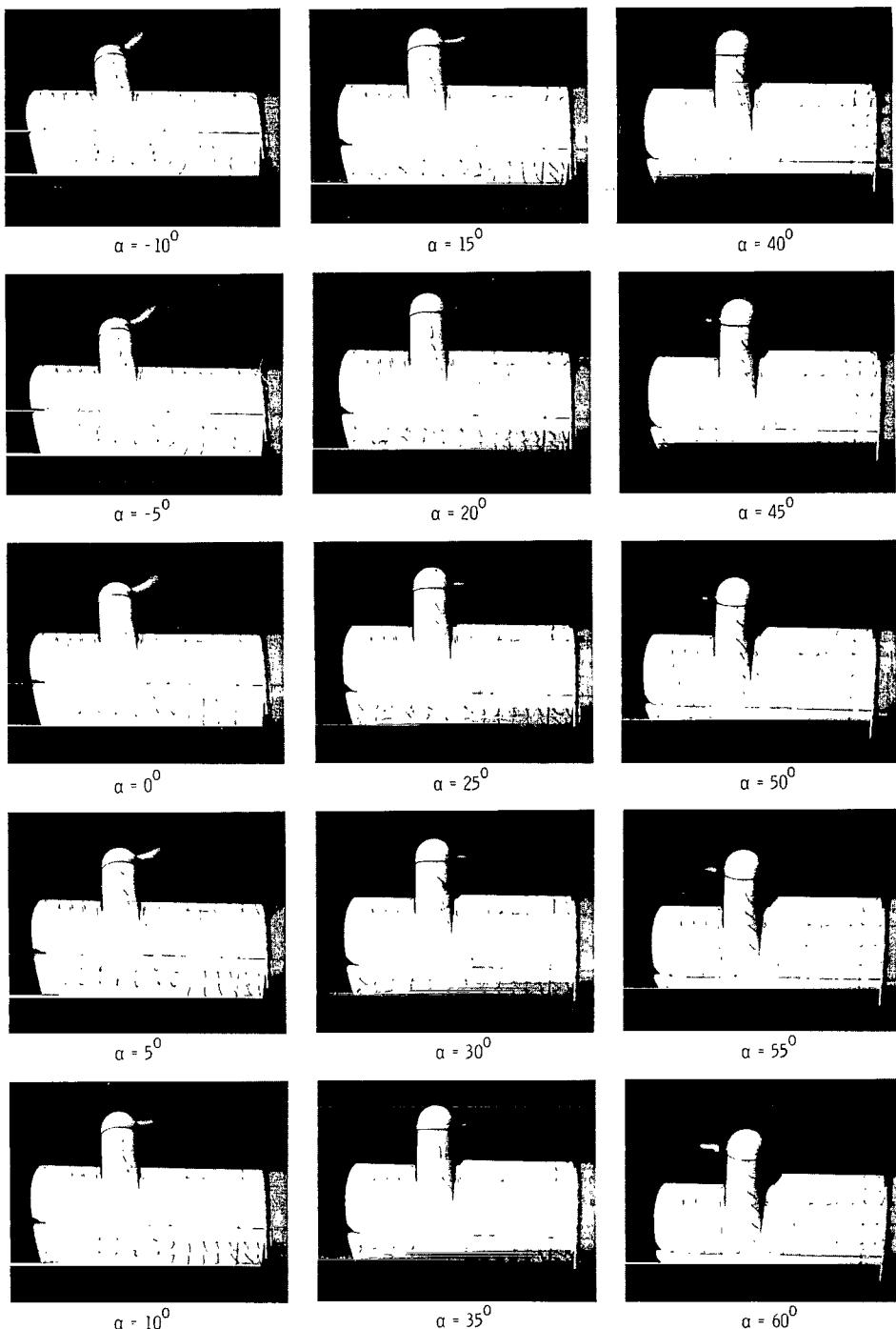
Figure 17.- Aerodynamic and flow characteristics of the model with the trailing-edge flap deflected 50° and with the inboard section of the Krueger leading-edge flap deflected 50° .



(b) Flow characteristics; $C_{T,s} = 1.00$.

L-64-4484

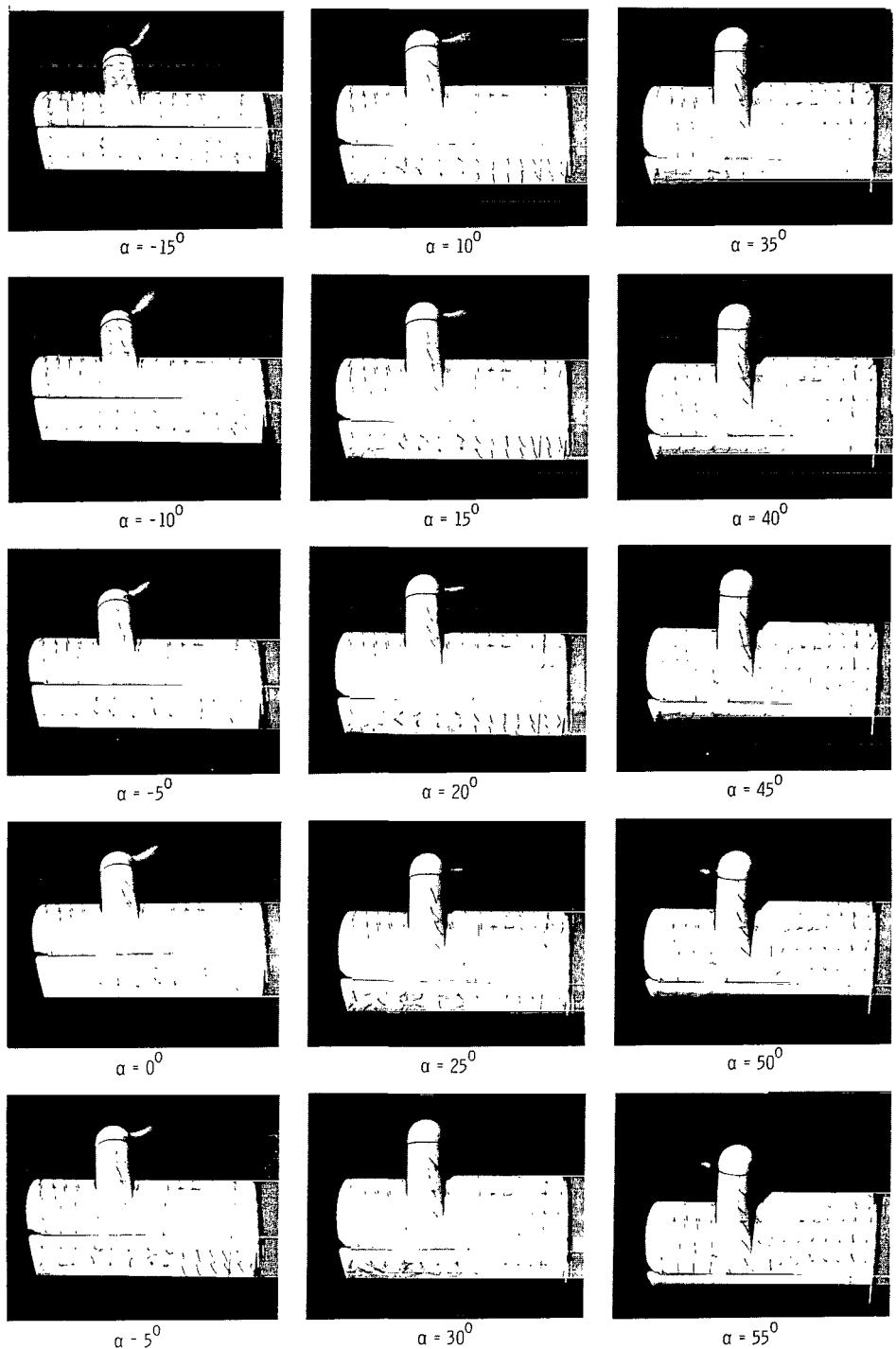
Figure 17.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95.$

L-64-4485

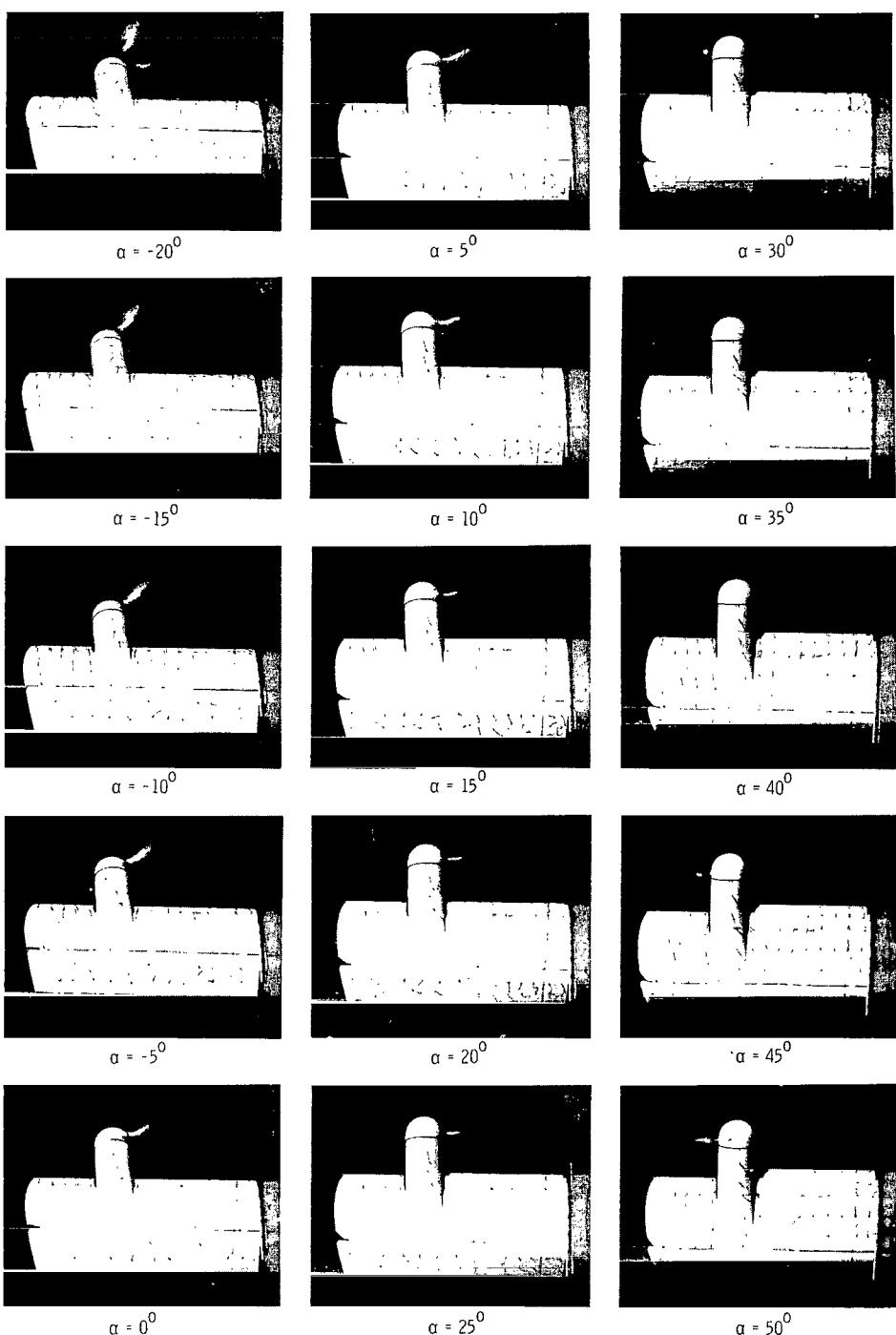
Figure 17.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4486

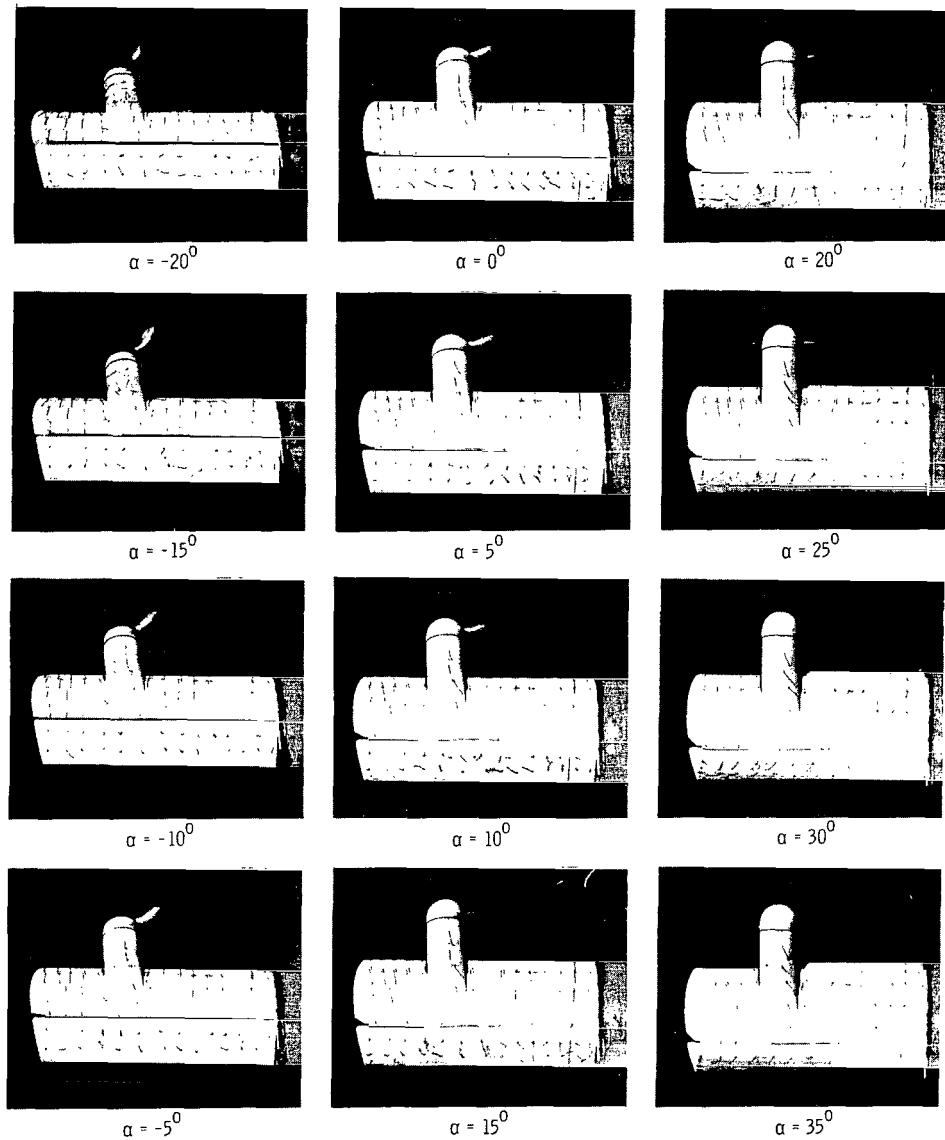
Figure 17.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4487

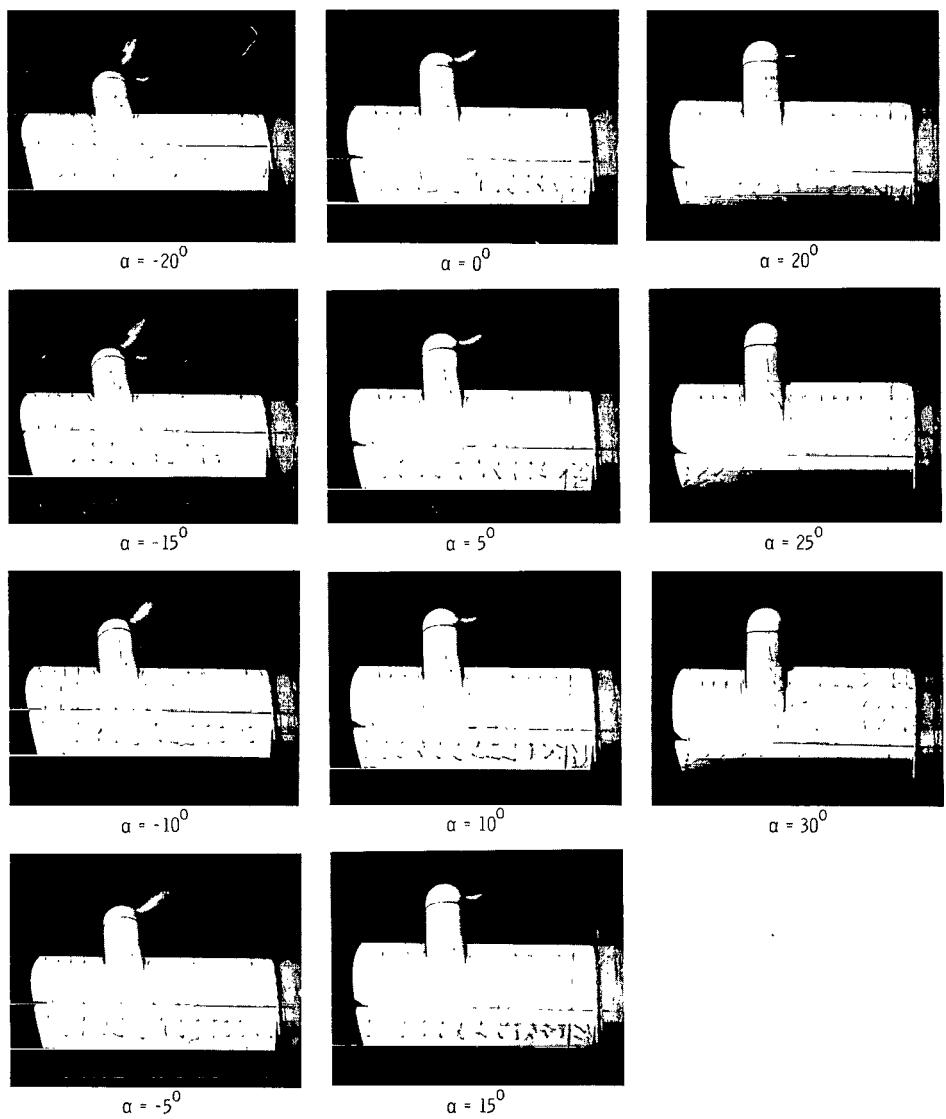
Figure 17.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60.$

L-64-4488

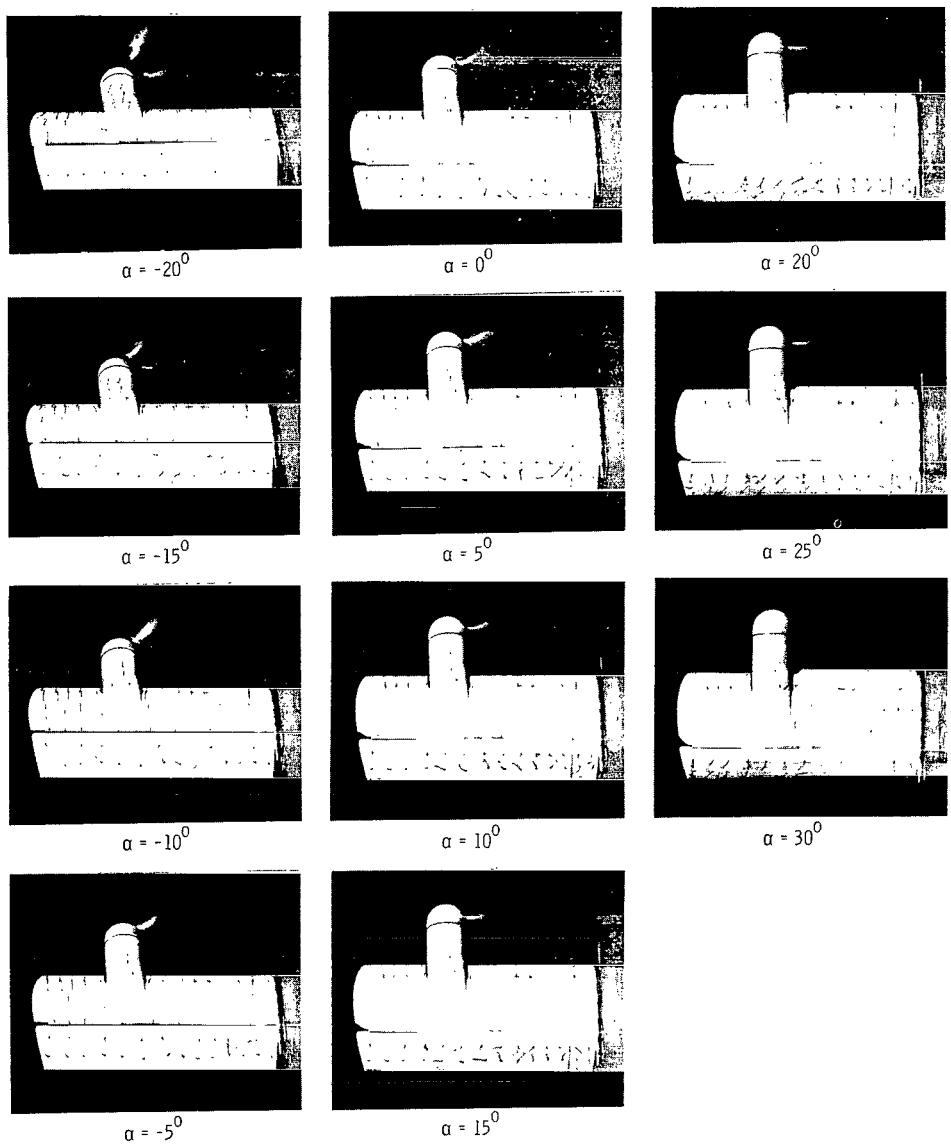
Figure 17.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30.$

L-64-4489

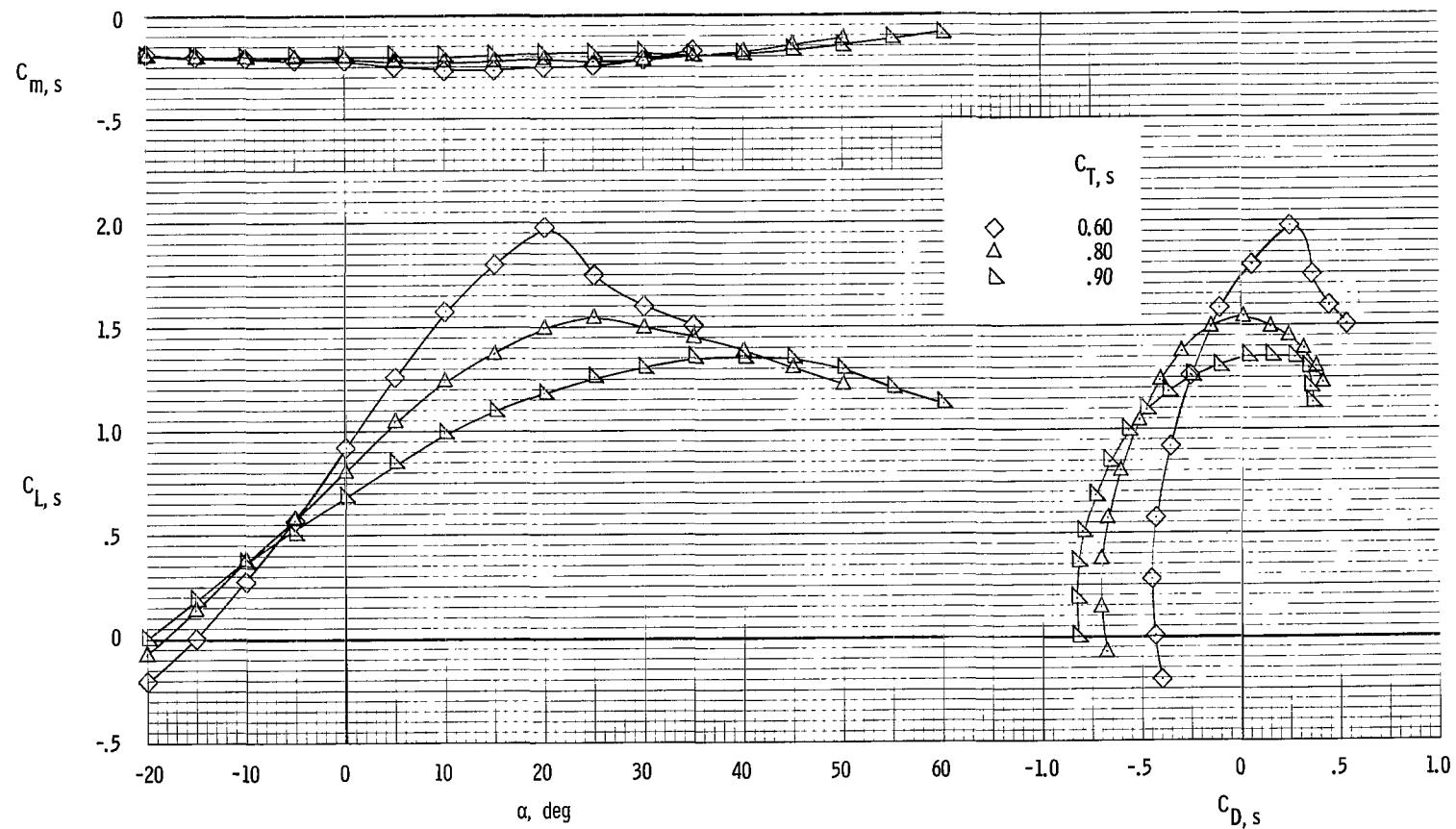
Figure 17.- Continued.



(h) Flow characteristics; $C_{T,s} = 0$.

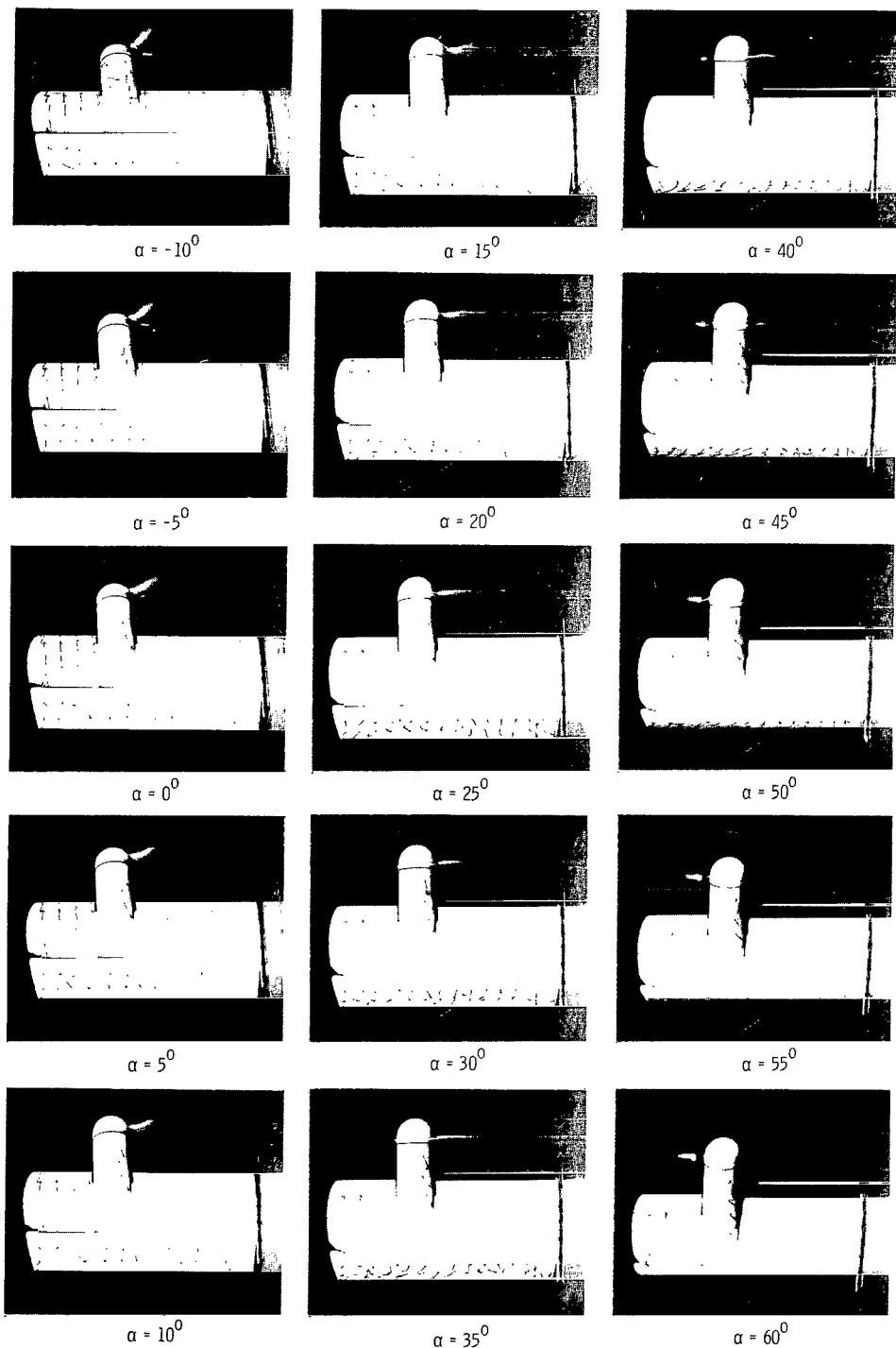
L-64-4490

Figure 17.- Concluded.



(a) Aerodynamic characteristics.

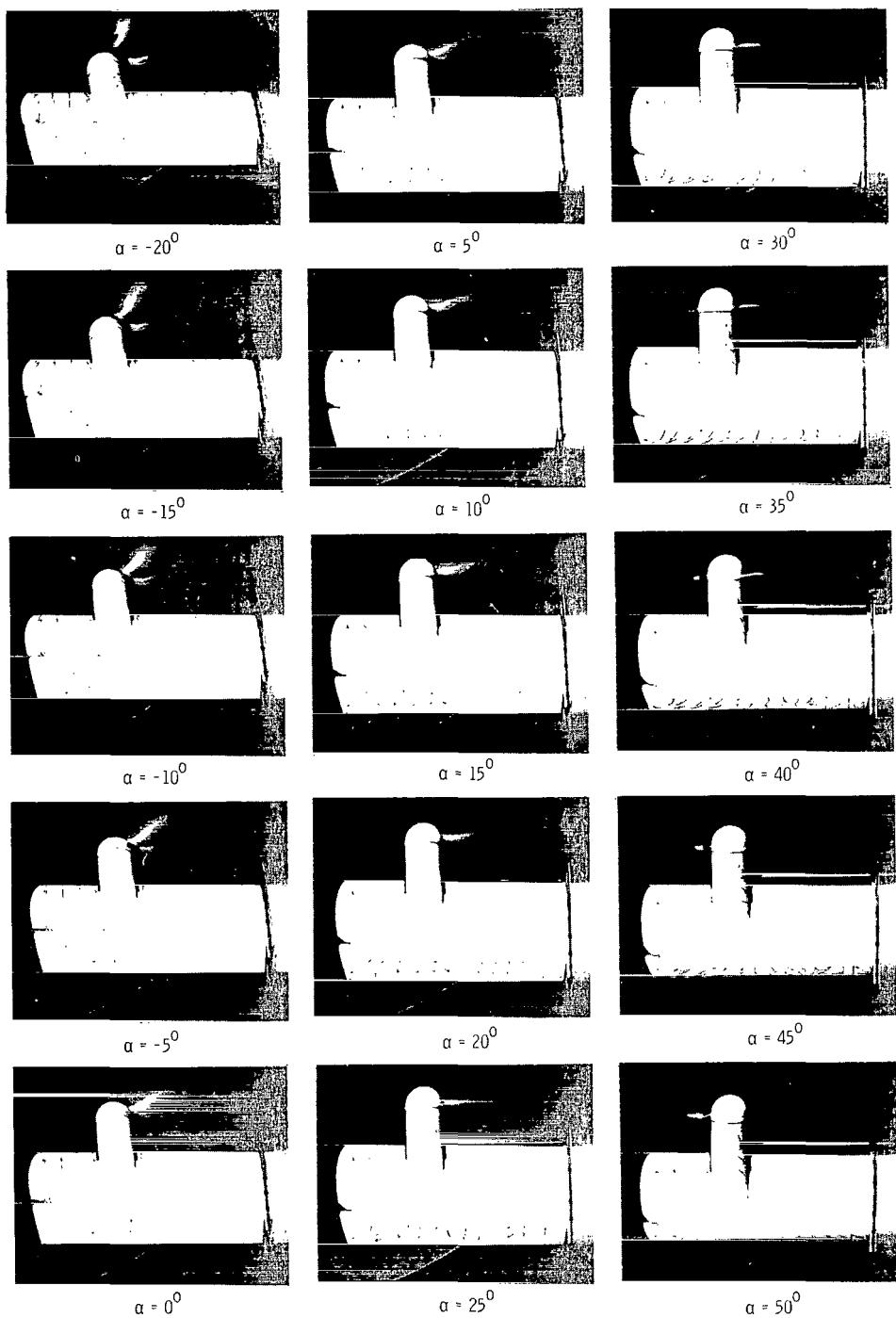
Figure 18.- Aerodynamic and flow characteristics of the model with the trailing-edge flap deflected 50° and with the inboard section of the Krueger leading flap deflected 50° and with Krueger faired to the airfoil leading edge.



(b) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4491

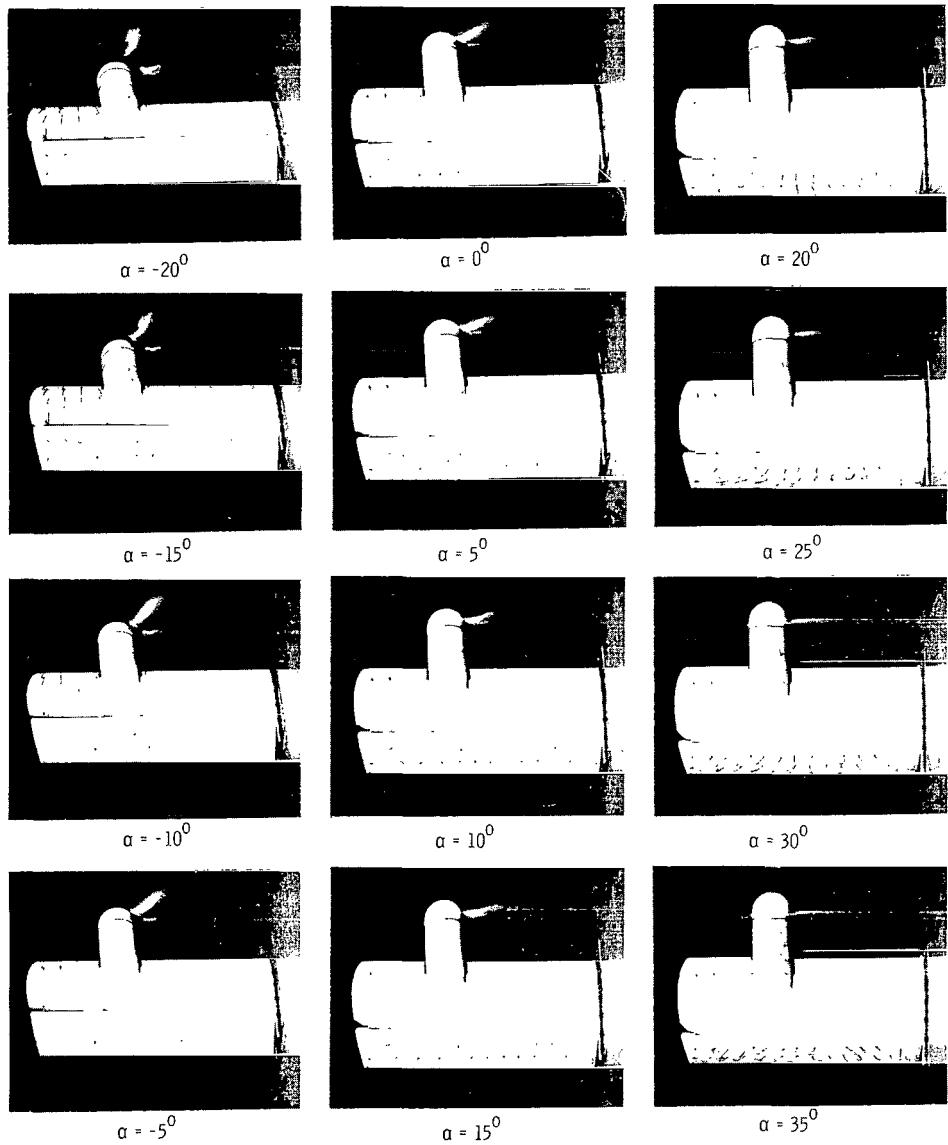
Figure 18.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4492

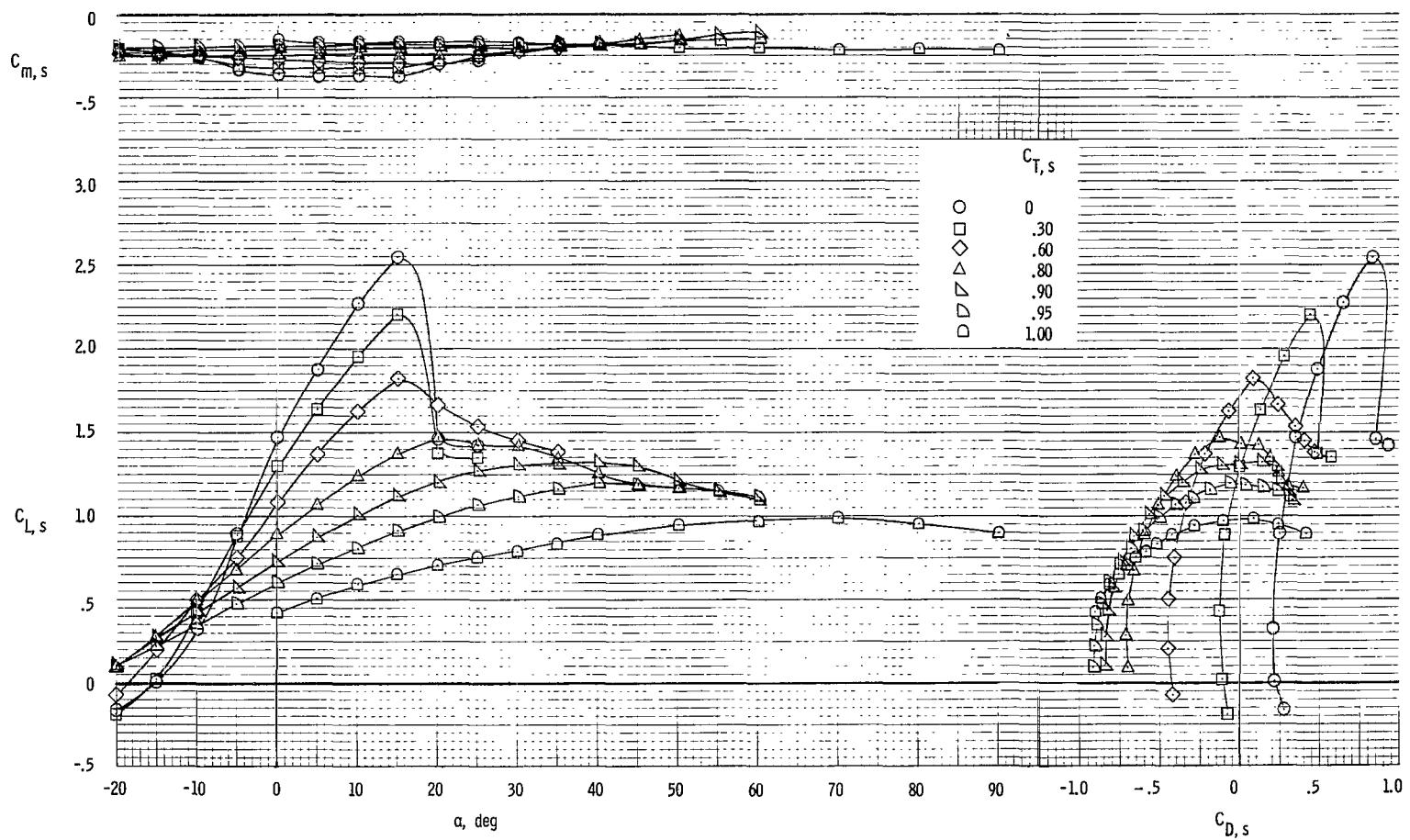
Figure 18.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.60$.

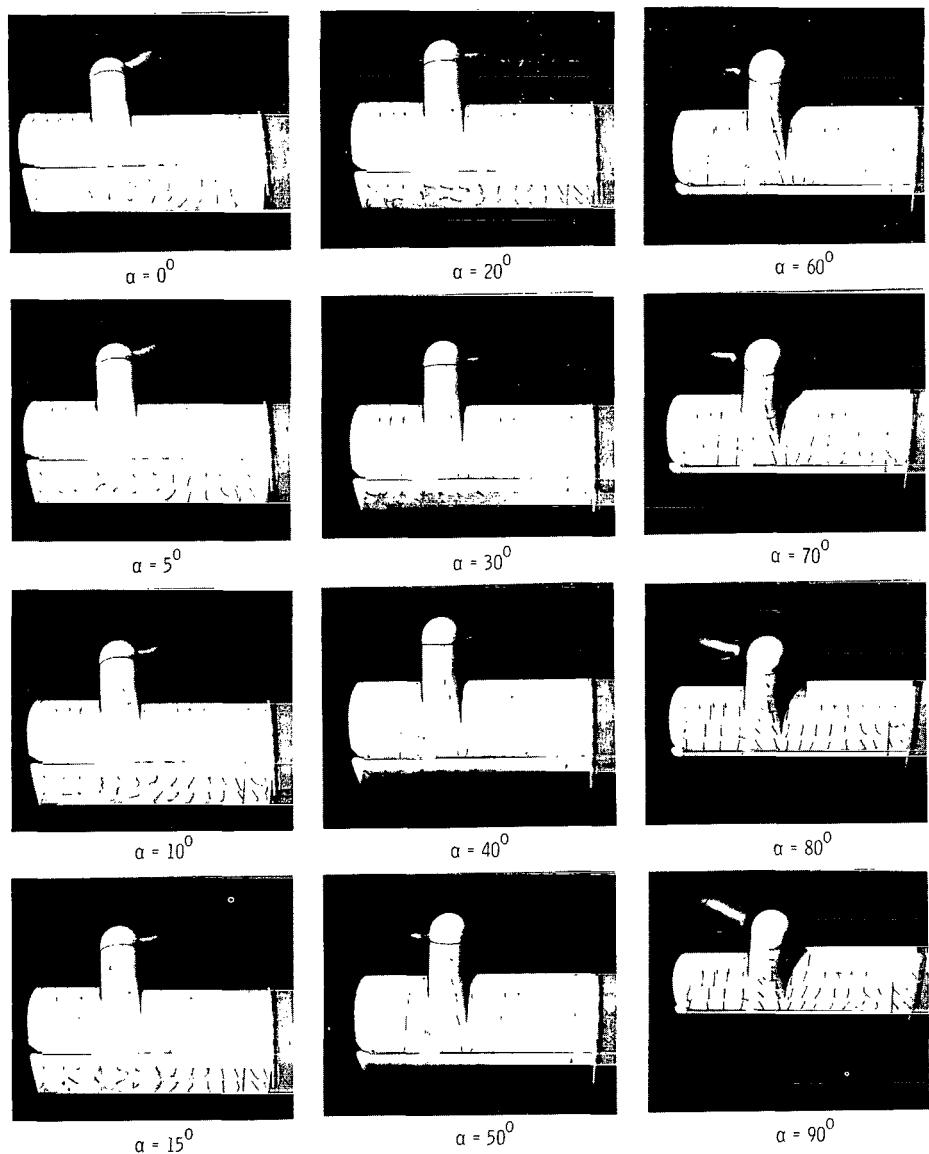
L-64-4493

Figure 18.- Concluded.



(a) Aerodynamic characteristics.

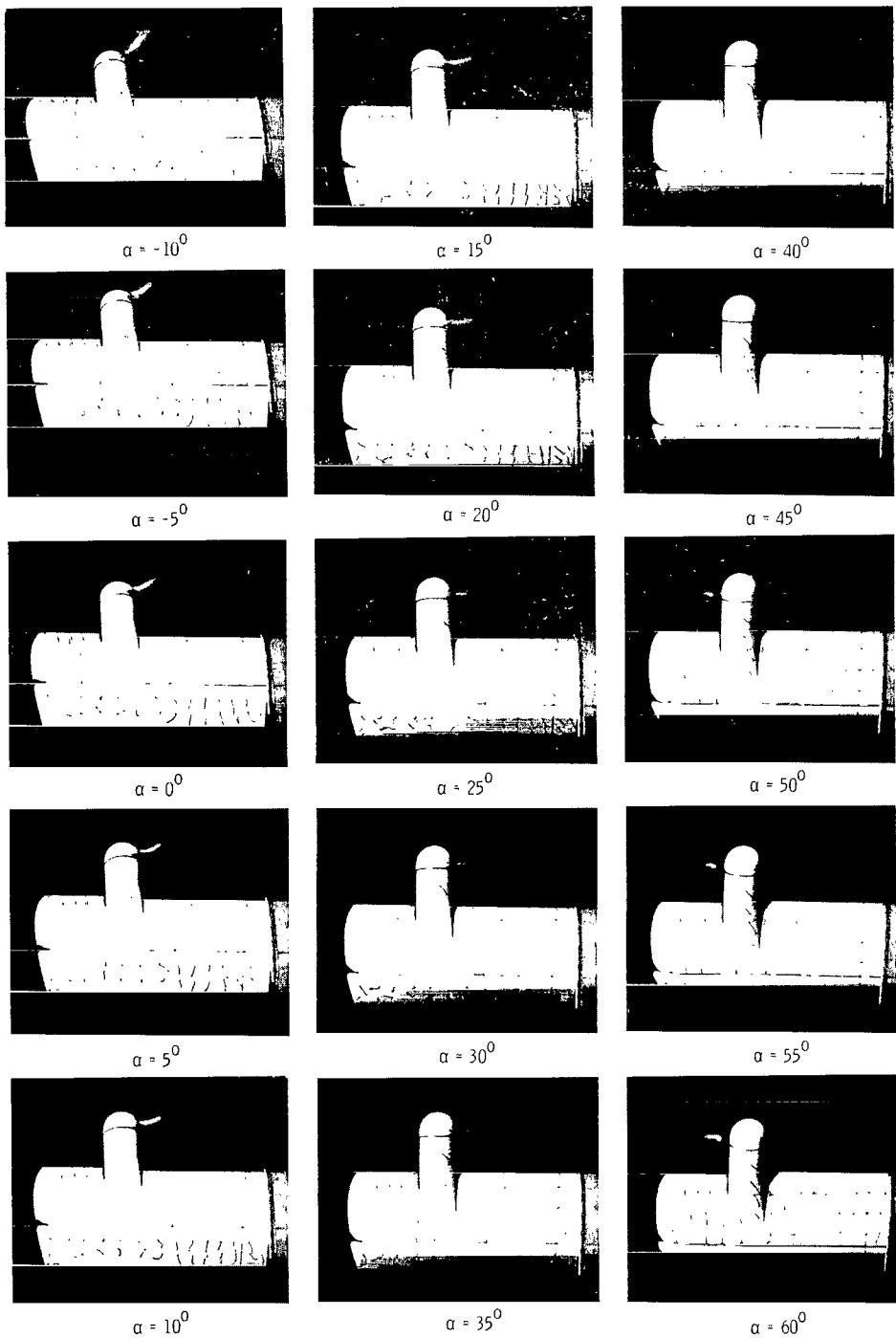
Figure 19.- Aerodynamic and flow characteristics of the model with the trailing-edge flap deflected 50° and the leading-edge droop (inboard) deflected 30° .



(b) Flow characteristics; $C_{T,s} = 1.00$.

L-64-4494

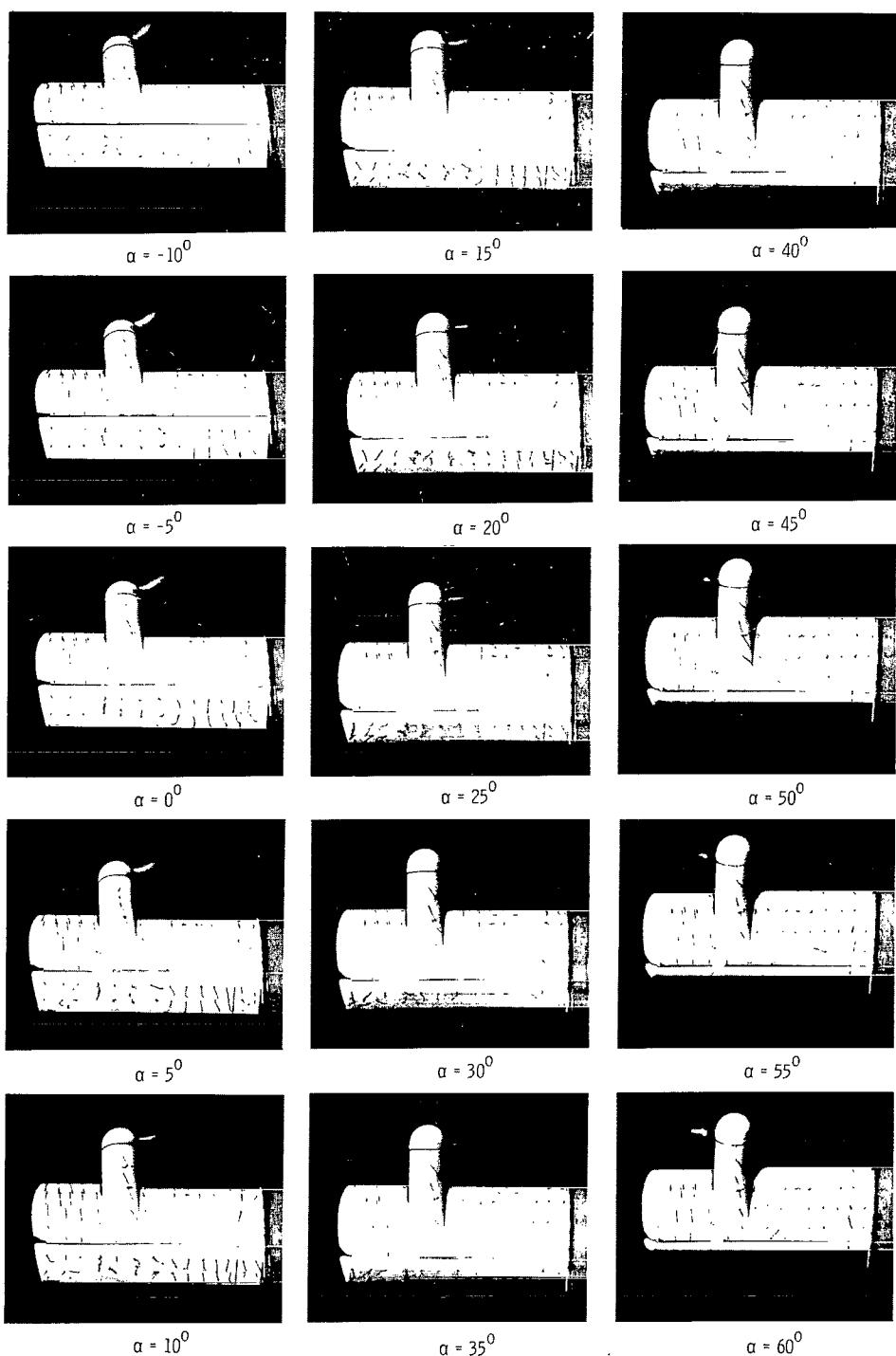
Figure 19.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-64-4495

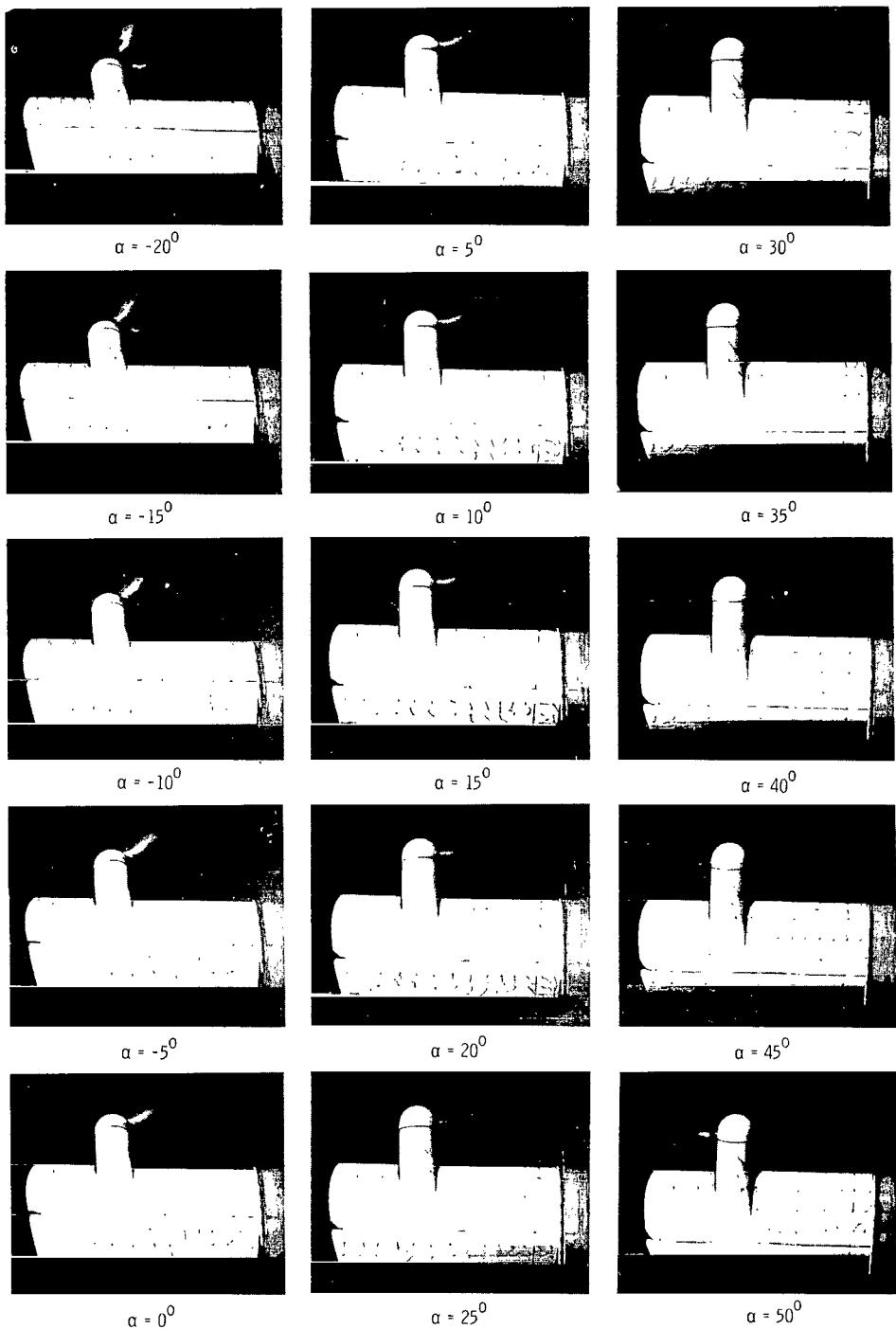
Figure 19.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90$.

L-64-4496

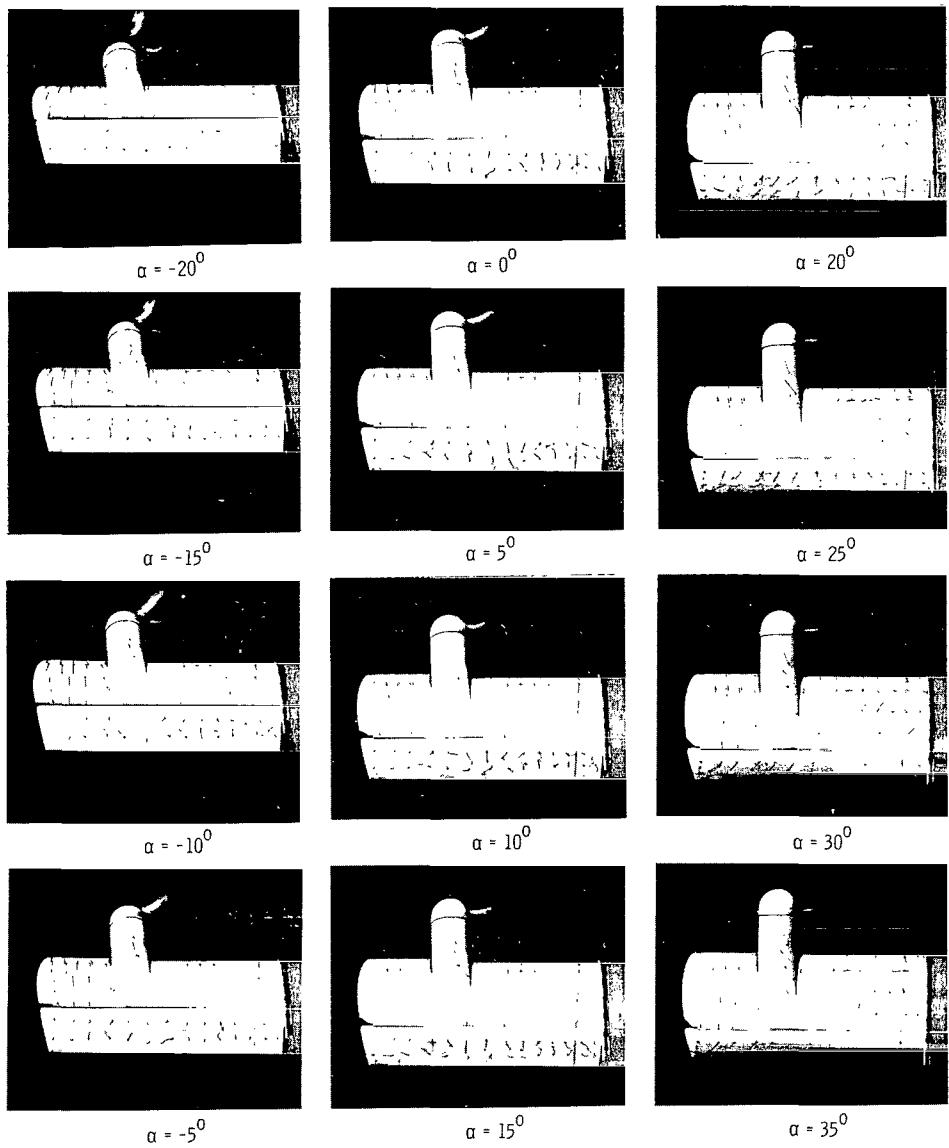
Figure 19.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.80.$

L-64-4497

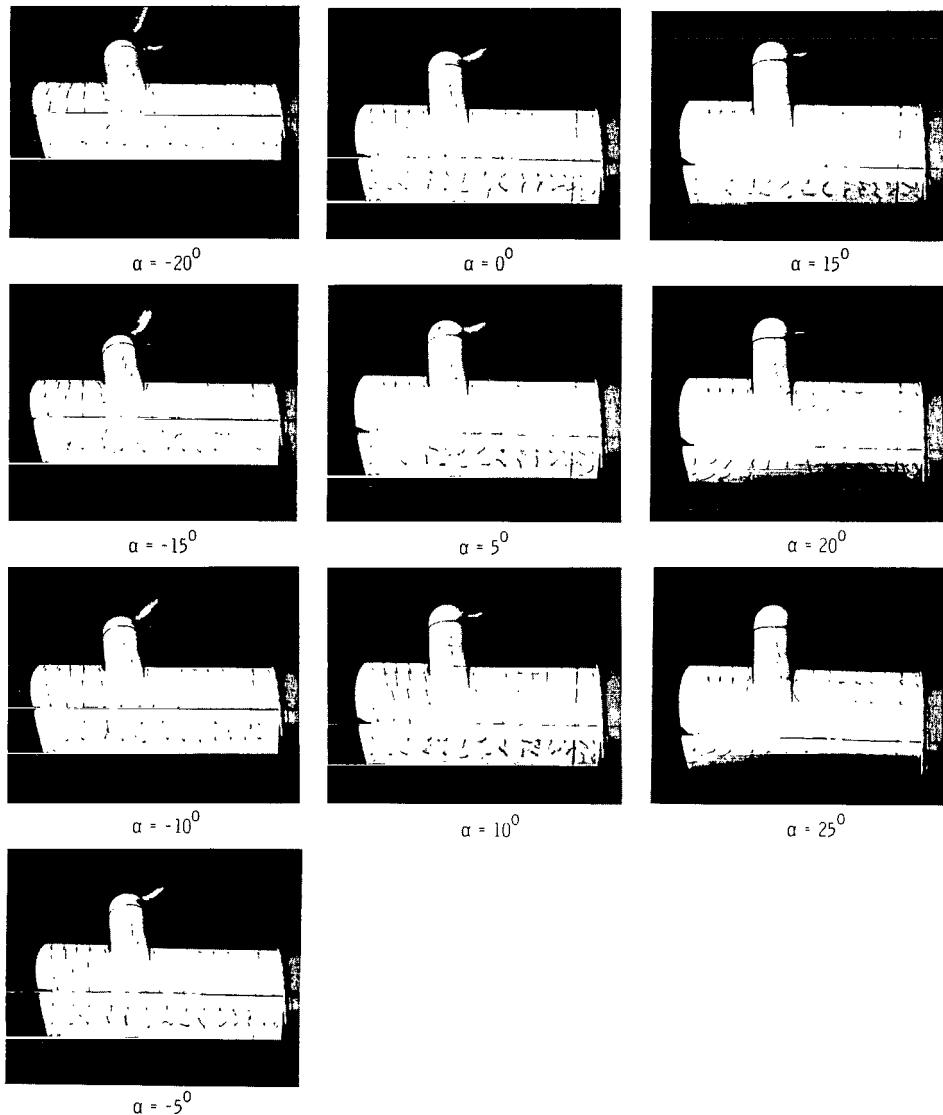
Figure 19.- Continued.



(f) Flow characteristics; $C_{T,s} = 0.60.$

L-64-4498

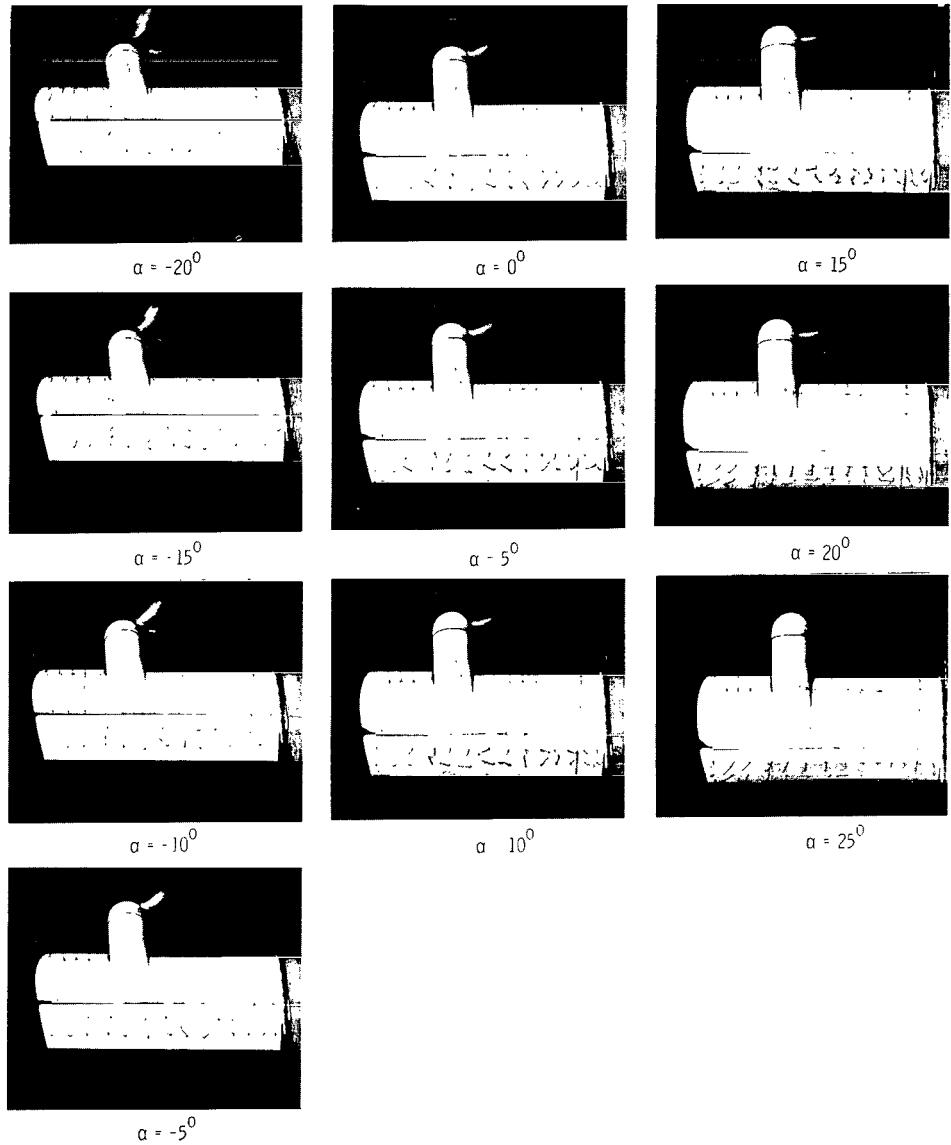
Figure 19.- Continued.



(g) Flow characteristics; $C_{T,s} = 0.30.$

L-64-4499

Figure 19.- Continued.



(h) Flow characteristics; $C_{T,s} = 0.$ L-64-4500

Figure 19.- Concluded.

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D

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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